PARK SCIENCE

A RESOURCE MANAGEMENT BULLETIN

NATIONAL PARK SERVICE
U.S. DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
U.S. DEPARTMENT OF THE INTERIOR

VOLUME 3 — NUMBER 3 SPRING 1983

PARK SCIENCE SPRING 1983

A report to park managers of recent and on-going research in parks with emphasis on its implications for planning and management.

IN THIS ISSUE: PAGE

Cover Photo:
Stock grazing in Cyclone Meadows, Sequoia-Kings Canyon National Parks.

From the Editor

Seldom does an editor feel inclined to "move over" and allow someone else to preempt the privileged editorial space. Because *Park Science* is dedicated to the presentation of research in terms of management and interpretation, this editor is delighted to share her space with a student — Peggy Herring — who recently turned in the following words as an assignment for a course in Natural Resource Communications taught by the editor at Oregon State University. Herring is an artist/biologist who also is a fulltime employee of the Oregon Dept. of F & W. Her succinct challenge to scientist/writers should be read along with Jim Wood's article on page 20. Together, these two pieces inspire and instruct the research person who aspires to be effective beyond the laboratory and the field.

By Peggy Herring

I am a biologist and I want to learn to write.

I believe that the privilege of doing research carries with it a responsibility for interpreting technical ideas for the interested public who may be footing the bill.

Scientific research too often is a facts-and-figures account of research and management. This is useful for people who already are specialists in the field, but it does not inspire those who have no confidence in themselves to understand scientific concepts. Scientific policy affects all citizens, and we should have access to these ideas. We need this information to help us make decisions and understand their consequences.

Topics of science can be presented clearly and simply without losing their accuracy. *Precision is relative to the needs of the audience.* With *modified precision* (NOT compromised accuracy), the most obscure technical idea can become readable, understandable, to a non-scientific audience.

Also, there is an added value in viewing research in less detail. Focus is broadened so that trends in thought and relationships to other work become clearer.

I have one more personal reason to want to learn to write well. The commitment to interpret a certain topic of science is a demanding and effective way of *learning* about the subject. To collect the small puzzle pieces of research and organize ideas into a larger design is to experience the joy of discovery. This organizational process would be the same if the product were to be a written article, a videotape, or an illustrated display. I am sometimes more fluent in drawing a picture than I am in composing the thousand words it represents. But to write clearly is to think clearly, and so interpretation becomes discovery.

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ISSN-0735-9462

PROTECTING MOUNTAIN MEADOWS: A GRAZING MANAGEMENT PLAN

By Stephen H. DeBenedetti and David J. Parsons

For more than a century, pack and saddle stock have been used in the western United States for recreation and as a management tool. Today, most large western parks continue to permit the use of such animals for both purposes. The character of such use, as well as the management restrictions governing it, vary with the history of the area. In Glacier and Rocky Mountain NPs stock are required either to use corrals or hitchrails or to be tethered in designated areas. In addition, all stock feed must be carried into these Parks. In Yellowstone, stock is allowed to graze from picket lines in designated meadows that are rotationally rested depending on conditions. In California's Sierran parks, grazing by free-roaming animals generally is permitted. In Yosemite, stock parties are requested, but not required, to carry feed. In Sequoia and Kings Canyon, grazing by free-roaming stock is the norm.

Impacts caused by stock use are primarily a function of the timing, frequency, and intensity of use. Impacts result both from herbage removal (grazing) and trampling. Grazing occurs primarily in meadow or other forage areas; trampling impacts can be found associated with meadows, trails, or camps. The susceptibility of individual plant species as well as moisture conditions and phenological stage must be considered in evaluating the potential for such impacts. Behavior of the stock and control exerted by the packers also influence stock-use impacts.

Given the decision (whether for historical, political, or other reasons) that pack and saddle stock use is to be permitted, it becomes the responsibility of Park management to determine what levels of use and impact are acceptable. For example, grazing management policies should aim to minimize adverse impacts to meadow ecosystems. This generally means that the timing, frequency, intensity, and nature of stock use may need to be controlled. However, informed decisions on what specific restrictions should be enforced depend on knowledge about the effects of different use patterns and practices.

Private and commercial stock use has been common for nearly a century on much of the land now within Sequoia and Kings Canyon NPs. Recreational stock use peaked in the mid-1930's when 72 commercial outfitters operated in the southern Sierra Nevada. Dependence on stock now is associated with only about 6 percent of total backcountry visitor nights. Nevertheless, at least 16 commercial pack stations currently operate in the Parks. Commercial, private, and Park Service administrative use now account for approximately 11,500 nights spent in the Parks by stock each year.

Starting with the work of Lowell Sumner in 1941, the NPS has conducted a series of qualitative surveys of meadow conditions in the southern Sierra Nevada. Reduction of vegetative cover, gullying and erosion, and the invasion lodgepole pine and "weedy" species were identified as serious impacts probably dating back to the late 1800's. Together with later surveys by Sharsmith (1959) and Sumner (1968), this information provided the basis for a grazing management program that has continued to the present and includes closing certain areas to grazing, restricting opening dates, and limiting the number of animals and length of stay. Management actions generally have been implemented on a case-by-case basis, most often only after the impacts have occurred. Together with evidence that subtle changes in species composition, abundance, and plant vigor have occurred with grazing, this has led Park managers to identify the need for more quantitative data on the impacts of grazing activities. Such data would permit the development of a grazing management plan that is both predictive and responsive to on-site conditions.

Development of the Plan

The first step is to establish management objectives. The objective for grazing management in Sequoia and Kings Canyon is to allow free-roaming grazing by commercial, private, and administrative stock, provided that:

1) continuous undirectional change in plant composition and/or vigor (productivity) does not result,
2) the sod or soil does not become increasingly erodable, discontinous, irregular, and
3) a network of meadows representative of each major type is protected from all stock use so that they remain as near to naturally functioning ecosystems as possible.

Clipping in simulated grazing plots

Other steps required in developing such a plan include a decision on the type of management system to be utilized and the development of a scientific data base on the effects of various grazing practices. In Sequoia and Kings Canyon, it was decided that the primary management tool would be a system of opening dates that would vary, depending on the type of hydrologic year and the vegetation and soils of the meadow in question. Additional restrictions, including closures or limits on number of head or duration of stay, would be utilized only on a meadow by meadow basis. Such restrictions might be based on total forage removed or the stage of development at which key species are grazed.

To meet the established objective, the Grazing Management Plan must provide a flexible system that (1) is sensitive to annual variation in climate, (2) considers the nature of specific meadows, and (3) is sensitive to the inherent ability of individual species to withstand grazing and trampling. Also essential is a monitoring program. The Plan must be sufficiently predictive to prescribe opening dates for specific forage areas in time for commercial operators to book their trips. The involvement of user representatives in the planning process adds greatly to the potential for compliance and acceptance.

Background Research

To develop a grazing management plan for Sequoia and Kings Canyon NPs, a 5-year research project was undertaken in 1973 aimed at understanding the composition, distribution, and susceptibility to impact of the Parks' major forage areas. The vegetation of each of these areas was described in sufficient detail to estimate the contribution of different plant communities to the total meadow acreage. A forage area was defined as a meadow or series of meadows and the dispersed forage in between that free-roaming stock would utilize when turned loose overnight from adjacent camp areas.

High-elevation meadows in the Sierra generally consist of a series of species groups, or plant associations, each with distinct characteristics (i.e. phenology, soil moisture, retention productivity, etc.) and tolerances to grazing and trampling. Such associations may be spatially distinct from one another (as along an elevation gradient), or they may be interspersed in a mosaic pattern, responding to such local environmental differences as surface irregularity. In the former case, animal behavior is often such that more sensitive areas may be avoided if preferred forage is available, for

instance, in drier areas. In the latter case, animals often cannot avoid trampling the more sensitive areas. The potential for avoiding sensitive vegetation must be estimated for each forage area as the vegetation is classified.

In our study we looked at total productivity and phenology in conjunction with the effects of simulated grazing (clipping) on selected plant associations. The intensity (degree to which a plant is grazed), timing (stage of phenological development at time of grazing), frequency (number of times grazed during a season), and periodicity (pattern of grazing from year to year) of herbage removal have different effects on different species and, thus, on different associations.

Since it was not possible to test experimentally all of the potential combinations of these factors, we chose to look only at intense herbage removal (within 2.5 cm of the root crown or surface, whichever was higher). The timing of herbage removal was varied with calendar date, while frequency of grazing was simulated by clipping one, two, or three times during the growing season and again at senescence.

In all, we tested four clipping patterns, plus a control, for each of six plant associations. Treatments were repeated for four successive years to simulate severe repeated pressure. In the fifth year, recovery of the clipped plots was measured. The most important plant associations were replicated at several points along a 1,200 meter elevational gradient to evaluate the effect of elevation.

Results have provided us with basic knowledge of the annual fluctuations in productivity of the major plant associations present in the Parks' subalpine and alpine meadows. Response of the most important associations to sustained multiple clippings also has been determined. Thus, the effect of different levels of herbage removal can be predicted and capacities (in animal nights) can be predicted.

Trampling also may have significant impacts on meadow vegetation, in the form of direct injury or mortality or as indirect changes in composition of the kind that occur when surface moisture patterns or soil stability is altered. The Parks' objective has been to minimize the potential for changes in composition due to trampling by minimizing potential disturbances of the surface soil and sod. To accomplish this, moisture conditions were monitored in key plant associations on a regular basis (every 7 to 10 days) from mid-June through August, 1978-1981. In addition, the degree, extent, and type of mechanical impact, if present, was described and correlated to the moisture conditions. This provided a predictive index of susceptibility to trampling by specific plant associations under differing moisture conditions. Such information provides the basis for estimating opening dates that minimize mechanical disturbance of the surface soil and vegetation.

Three important types of easily recognizable mechanical impacts observed were: (1) broken sod, which includes the imprinting, gouging, tearing, or shearing of the soil-vegetation complex, occurring most often when the surface soil is wet or moist; (2) scuffing, including the slicing or abrasive removal of aerial vegetation, occurring in mesic or drier sites; and (3) pulverization, the fragmentation or disintegration of the soil pedestal or soil-vegetation complex that occurs with severe trampling, most commonly under xeric conditions where vegetation is discontinuous.

While we feel the occurrence of broken sod can be minimized by means of adjusting opening dates according to moisture conditions, closer monitoring and additional restrictions may be necessary if pulverization or scuffing levels are considered unacceptable.

Exclosures used in clipping studies.

Implementation of the Plan

Once the manager has information concerning the activity patterns of grazing animals, the composition of individual forage areas, the productivity of different plant associations, their responses to different herbage removal patterns, and their moisture regimes and susceptibility to mechanical impact, the tools are available to develop use prescriptions for individual forage areas that will have predictable results. The next step is to choose the degree, type, and extent of impact acceptable and adjust the intensity, timing, frequency, and periodicity of use accordingly. For example, a given forage area would have a specific opening date and may have limits on total stock nights, either for the year or at any one time. These restrictions may vary depending on whether it is a wet, dry, or normal hydrologic year.

The grazing management system will succeed only if it can be understood by those who must use and enforce it. In Sequoia and Kings Canyon, opening dates are now prescribed for three types of hydrological years (wet, normal, and dry); thus it is possible for the user to know well in advance the opening dates for specific forage areas.

Once acceptable use prescriptions have been generated, the manager may find it necessary to ration or allocate use in strategically located or popular forage areas. Available options include head limits, length of stay limits, and scheduled closure periods.

Where levels or patterns of use are potentially unacceptable, it is necessary to develop an effective use-monitoring scheme. If biomass removal or the percent of preferred plants grazed is used to define acceptable use levels, either direct measurement of these factors, or estimates based on the number of stock days occurring must be utilized. Because of manpower shortages, in Sequoia and Kings Canyon we have developed an extensive use-monitoring system as an alternative to direct measurement. Administrative, commercial, and private stock parties are required to file an itinerary on completion of each trip. More than 90 percent of all stock use now is accurately reported.

As a final, important phase in our Grazing Management Plan, it has been determined that a network of meadows representative of the major types found in the Parks will be protected from all stock use. These natural functioning ecosystems have been selected so as to minimize inconveniences to users and to include as many remote areas as possible.

In summary, a grazing management system for free-roaming stock in western national parks must be based on clearly defined objectives and standards of acceptable impact. The vegetation and surface characteristics of each important forage area must be inventoried and response of specific plant associations to grazing and trampling known. Animal preferences and behavior may be important and should be evaluated. User characteristics and patterns in specific forage areas should be analyzed in order to develop the most appropriate management strategy where overuse might occur. A use-monitoring system also must be developed. The involvement of user groups in the planning process improves communications and assures that the manager has a clear understanding of the user perspective.

Parsons is a research scientist and DeBenedetti is a biological technician at Sequoia-Kings Canyon NP.

SCIENCE, POLICY, AND POLITICS: WORKING TOGETHER AT CRATER LAKE

By Jonathan B. Jarvis

Crater Lake, the central feature of Crater Lake NP, has been admired by visitors and scientists both as a spectacular and unique resource. It has been called the clearest lake in the world, a natural analog of distilled water, a scientific benchmark in limnological research, and has been attributed to have the greatest transmittance of light of all natural waters. It has, unfortunately, been the object of only limited research between 1886 and 1978.

Morphometry studies have shown Crater Lake, at 589m deep, is the deepest lake in the U.S. and the seventh deepest in the world. Formed in a caldera less than 7000 years old, it is geologically young and considered oligotrophic. Physically protected by surrounding 100m to 600m cliffs, and managerially protected by 1902 National Park designation, Crater Lake has been thought of as well preserved and protected from cultural impacts. However, research from 1978-81 (by Doug Larson) raised questions about the limnological dynamics of Crater lake. An indication of a reduction in the lake clarity quickly aroused attention from the public, political, and scientific communities. The following is an explanation of how these forces interacted to formulate the current management direction for Crater Lake and the related caldera ecosystem.

The Research Community

Past research on Crater Lake has focused on the optical properties, morphometry, geology, fisheries (stocked), temperature gradients, and plankton distribution. It has been noted that the unique features of Crater Lake such as its geothermal input and lack of surface discharge present problems in applying classical limnological knowledge.

Data gathered to this date has been inadequate to determine if observed changes are natural trends or indicators of human impact. The most significant change has been a decrease in Secchi disk transparency from an average of 36.6m in 1968-69 to an average of 29.3m in 1978-79 (Larson and Mark Forbes). Speculation relates the cause of this decrease to human influence or atmospheric deposition but it may be a natural trend.

The Public

From its time of discovery by European man in 1853, Crater Lake has held in awe all who view its deep blue vastness contrasted with the stony caldera walls. Over 500,000 visitors a year see the lake from the rim drive while 3 percent take the arduous 2 km descent to the lake level on the only access trail. Concession operated boats offer that visitor an opportunity to experience the lake from surface angles that enhance the almost bottomless blueness of the water. These experiences kindled media interest and public outcry when word spread that research indicated Crater Lake clarity was diminishing.

The Political Arena

Riding on the momentum of the 1980 State of the Parks Report, an amendment to Senate Bill S-1119 was sponsored by Rep. Denny Smith (R-Ore) in Dec. 1981, requiring a biennial report on the quality of Crater Lake over the next 10 years. The bill passed as Public Law 97-250 in Sept. 1982 and directed the Secretary of Interior to "instigate studies and investigations as to the status and trends of change of water quality of Crater Lake and to immediately implement such actions as may be necessary to assure the retention of the lake's natural pristine water quality."

Current Management Action

Crater Lake NP recognized in early 1981 that a research program was needed for the lake and consequently identified the caldera (lake) ecosystem as its primary resource project in the park Resource Management Plan. Consultation with all concerned parties and the added impetus of the supporting legislation in 1982 has helped Crater Lake NP Resource Management refine its program into a comprehensive, systematic approach to research and monitoring of Crater Lake.

A. Recognizing that inadequate information exists to interpret trends, primary emphasis has been placed on collecting baseline limnological data. Direct cause and effect research based on speculation has been thus far avoided to prevent costly outlays. However, a basic monitoring program has been designed to determine impacts of park use and management of the lake system. If degradation trends are indicated from baseline research, then future cause/effect studies will be directed toward identification of the source.

B. A professional limnologist, Dr. Douglas Larson, has been brought onto park staff on a part time basis to ensure accurate scientific data analysis and provide overall program direction.

C. An NPS seasonal employee, working towards a Master's degree at University of Oregon, began in 1982 basic chemical sampling (DO, pH, TA, SC), biological sampling (chlorophyll and phytoplankton identification and counts) and physical sampling (thermal profiles and Secchi disk depths).

The Secchi disk *winks back at the camera from 20 feet of Crater Lake water.*

Crater Lake (continued)

D. An on-site laboratory has been equipped with the capability of basic data analysis and sample storage.

E. A platform boat has been placed on the lake and equipped for use by Park Resource Management staff and researchers in data collection.

F. With the assistance of Oregon DEQ, Crater Lake NP has begun monitoring some parameters of air quality. Park management is seeking ways to expand the air quality program so that any correlation between lake quality degradation and atmospheric deposition can be determined.

G. Annual Crater Lake research meetings were begun in 1982 at Oregon State University to provide scientific peer review of the program, to critique research results and to advise redirection of emphasis.

H. Research results and management plans are being shared with the public by park interpretive staff.

The Crater Lake research program is still in its early stages. However, its direction is one that will identify the problem, provide new limnological insights, assist park management, and satisfy public and political interests and concerns. The program's initial success shows how a multidisciplined constituency can work together to solve some of the problems facing our National Parks today. Ensuing articles will report the progress and results of this continuing research effort.

Jarvis is Resource Management Specialist at Crater Lake NP.

Superintendent's Corner

Sequoia National Park was the site, last fall, of a remarkable experience in team science — one that already has been beneficial to us, and that promises to be even more valuable when the next phase is completed. At its center were Dr. Jerry Franklin of the U.S. Forest Service, Corvallis, and a remarkable team of scientists, students and technicians from Oregon State University.

Working with shoestring funding received through the National Park Service Interdisciplinary Science Team program to conduct interdisciplinary investigations on the structure and functions of Sierran stream-forest ecosystems, Dr. Franklin and a team of 30 arrived in the Park in September, 1982. The team worked from dawn to dark for 10 days, carrying out intensive field studies of stream, riparian and forest systems in a mixed-conifer forest, a giant sequoia forest, and a meadow. The program was modeled after previous highly successful "pulse" studies in the Cascades and in the Olympic Peninsula.

Nightly campfire sessions provided opportunity for structured, but very lively, discussions of project objectives, progress, and application to Park needs. These sessions were open to Park staff, who frequently were able to provide valuable insights.

As a participant myself, I can personally attest to the fact that we *gained* knowledge and insights, and were caught up in the excitement of a highly professional, highly interactive group's procedures and findings. Sequoia resource management and science staff also participated in some of the field work, gaining valuable training in field techniques. The group went to great lengths to assure maximum applicability of their findings to such on-going Park programs as basic resources inventory, acid rain research, and long-term monitoring of vegetation changes, the effects of fire, and water quality. In developing a data base on the structure and function of selected Park ecosystems, the "pulse" study is providing interdisciplinary information of a kind that most Parks unfortunately seem to have little hope of obtaining.

Dr. Franklin is to return in June with an even larger group. We plan to take full advantage of the opportunity to establish what I hope will be a firm foundation for other long-term interdisciplinary research projects in Sequoia and Kings Canyon National Parks/International Biosphere Reserve. The results are sure to be very valuable to us, as we work toward the kind of ecosystems knowledge that is essential to sound management of the Park's resources.

Boyd Evison, Superintendent
Sequoia & Kings Canyon NPs

Research Focuses On Acid Rain

By Kathy S. Smith and Jill Baron

Recent investigation into the status of acid rain research showed that NPS personnel at all levels are active in surveying and assessing problems. A number of NPS areas are looking into the processes by which change may be expected to occur; Rocky Mountain, Shenandoah, Great Smoky Mountains, Sequoia, Isle Royale, and Voyageurs are among the parks which have intensive studies asking the question of *how* acid rain damage might occur.

Research emphasizes soil and bedrock weathering, and effects on aquatic biotic and abiotic systems. Work investigating effects to terrestrial vegetation is limited, however, as basic research now underway by other agencies progresses, new methods will allow evaluation of vegetation — a prime Park resource. The importance of future terrestrial studies is stressed by new evidence from Germany which postulates forest to be in a state of advanced decay as the result of decades of nutrient leaching by acidic rainfall and heavy metal deposition. Is this a future park issue?

NPS cultural resources staff also are aware of the risk to diverse materials under their care. Unfortunately, knowledge of actual effects on historical resources lags far behind our presently incomplete and often contradictory knowledge of biological effects. Progress is being made, however.

The National Park Service is involved, through the Office of Historic Architecture, in materials effects and in restorative research, finding protective coatings, or "sacrificial layers" which will save the important structures underneath.

A national debate is underway! Acid precipitation is a reality! At risk are ecosystems, monuments, forests, buildings, and a number of aquatic and fish species. Sensitive National Park areas represent protected natural systems where the potential changes due to acid rain must be understood.

Additional information regarding acid rain, what it is, what it does, and where it comes from is available in the report entitled "Status Report: Acid Rain Research in the National Park Service 1982" is a Water Resourse Field Support Laboratory publication, WRFSL Report No. 82-1 and is available from the Lab, 107C Natural Resources, Colorado State University, Fort Collins, CO 80523.

Baron is a research biologist with the NPS Water Resources Field Support Laboratory. Smith is a journalism student at Colorado State University. See also Information Crossfile for associated items.

PARTNERSHIP SEEN AS KEY TO APPLIED PARK SCIENCE

The formation of a partnership between management and the scientist is the key to the application of science in the National Parks, according to Donald R. Field, Chief Scientist for the Pacific Northwest Region, in a talk before the First Biennial Conference of Research in California National Parks, held in September 1982 on the Davis campus, University of California.

"My experience suggests," he said, "that it is not so much the content or subject area of research that ensures integration into the decision making process as it is the manner in which the research is undertaken and communicated to park management."

The responsibility for defining a research agenda, Field said, lies with the management of the National Park Service. That research agenda emerges from the Resource Management Plan. He described the limitations of science to solve all management problems and the constraints of management to incorporate science into the decision making process.

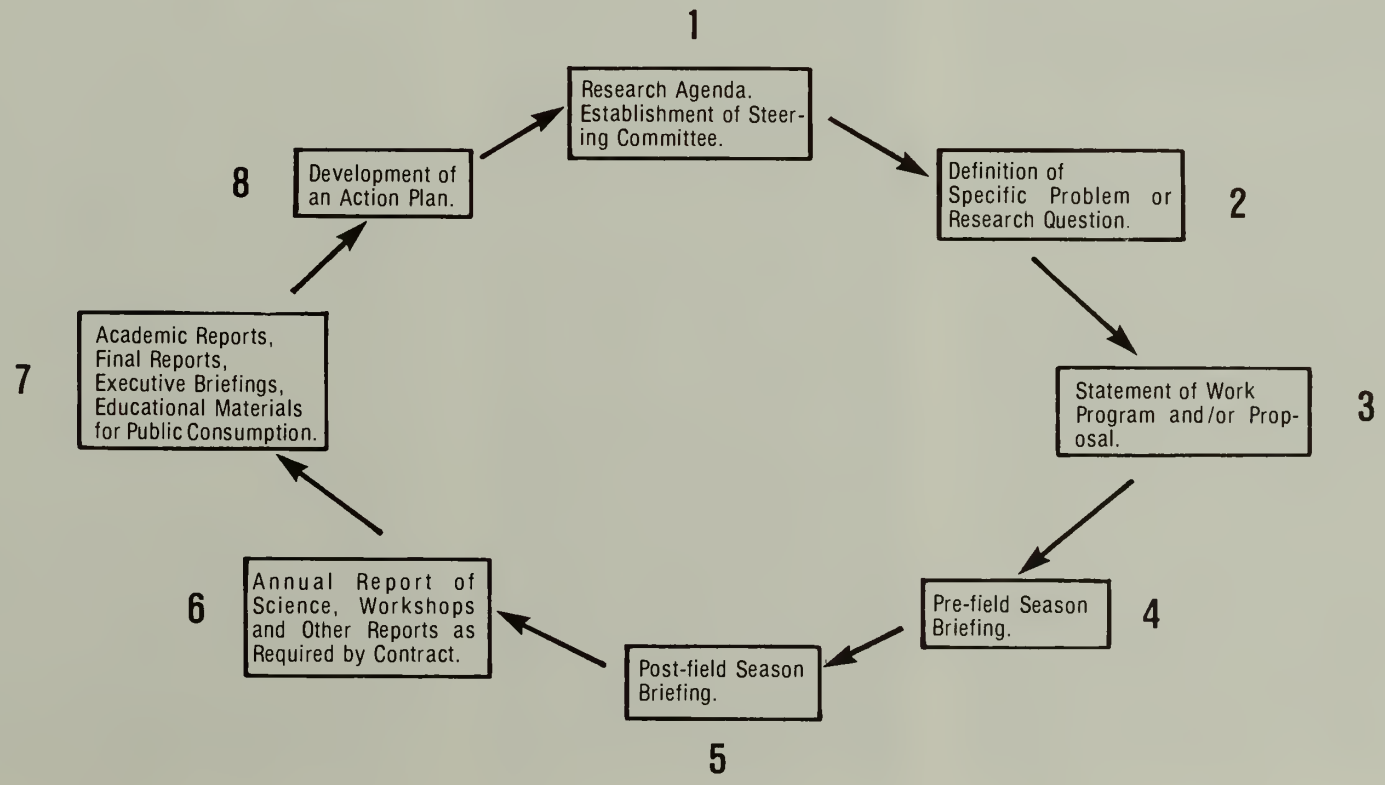
Research plan formation has been structured to include scientists and managers as partners, and this interaction extends into establishment of the specific research question. The need at this second stage is to pose the research question in such a way that it *can* be answered by research, and to establish the *need* for that research (instead of, say, a literature search, which might be sufficient.)

A third important step is agreement between scientist and manager as to what the research can be expected to produce. At this stage, three issues still need to be mutually resolved: the timeing and pacing of the research activity, the selection of variables, and the actual research design (which often must reflect a compromise with the *ideal* research model.)

Even negotiation of all these potential pitfalls does not insure success. "A critical period of uncertainty," Field pointed out, "is the end of a field season, before the first interim report. Communication at this stage," he emphasized, "enhances credibility, confidence, and support for the project."

The final report for management should be prepared with management's needs firmly in mind. Does the research provide a practical solution? Is it to be used in the public involvement process? WIll it go into the preparation of an environmental or a social impact assessment? Will the scientist be expected to testify in a court of law or represent the agency at a public hearing? Executive summaries and action documents detailing implications and alternatives, Field noted, are essential for management action plans.

STEPS IN THE COMMUNICATION OF SCIENCE TO RESOURCE MANAGERS



Research Facility at Jackson Hole Fuses Joint Effort

Editor's Note: The following is excerpted from a series of news releases by Karl Harper of the University of Wyoming News Service. The series was sent to **Park Science** *by Neil J. (Jim) Reid, chief scientist in the Rocky Mountain Region of NPS, as indicative of the best in cooperative research taking place in the National Park System today. As Reid puts it, "The NPS-University of Wyoming Research Center near Moran is doing yeoman service in finding solutions to management problems, while at the same time providing opportunities for the on-going "pure" research that is so vital to our long-range understanding of how parks function."*

Unique.

That's the University of Wyoming-National Park Service Research Center on the shore of Jackson Lake in Grand Teton NP: the most complete research facility operating in any U.S. National Park, the only one supported jointly by State and Federal monies, and the only one administering activities in a four-state area.

From May to October each year, the Center is the hub of biological, social, and physical sciences research by investigators selected from 70 institutions and agencies nationwide. Their studies are directed mainly toward problems or subject areas that have direct bearing on National Park operations and management in Wyoming, Montana, North and South Dakota.

General research priorities are established by a Center steering committee of eight members — four NPS officials and four UW faculty members — with the Center director, Kenneth L. Diem, UW professor of zoology and physiology, serving in an ex officio capacity. The committee evaluates proposals addressing areas of priority concern and sets project support budgets for most of the studies, although a significant number are funded by outside sources.

The NPS and UW share equally in the Center's $200,000 annual budget, of which 65 percent is earmarked for research. About 80 percent of the research program is of an applied, goal-oriented nature, with the balance for basic research. The practice, according to Diem, has been to limit the number of Center-based projects to about 25 in any one season, with others assigned to various locations in the four-state area. Most are granted support for no more than three years.

Fifteen investigations currently are in progress at the Center or have been scheduled for completion or start during the 1982-3 season. Seven others are based elsewhere, but are being conducted under the aegis of the Center. Although most are relevant to National Park applications, some have broader — even global — implications.

Kenneth L. Diem, *professor of zoology and physiology at the University of Wyoming and director of the UW-NPS Research Center, surveys his quiet domain from the boardwalk connecting the Berol Lodge with the Johnson house. Residence and service buildings are spotted in the meadowed bowl shielded from view of the thousands of tourists who daily pass on the highway to Moran and the town of Jackson to the south.*

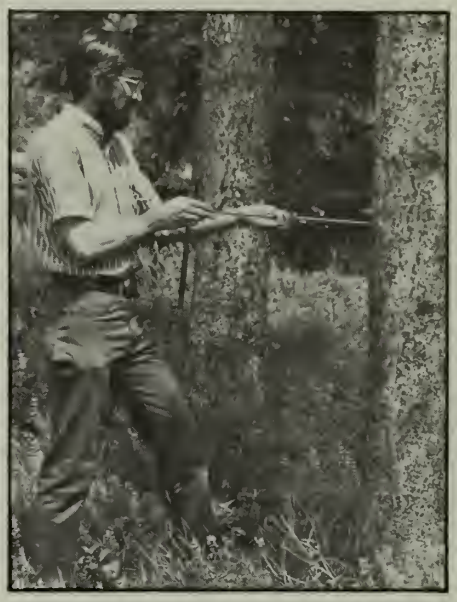
Examples this season include studies to establish baseline data and fundamental inventories of park resources, to assess factors bearing on understanding the productivity of Yellowstone Lake, to improve the accuracy of visitor statistics obtained in Grand Teton NP, to further catalog the bewildering variety of mushrooms native to the area, to document the population dynamics of the mouse-like voles that are a staple in the faunal food chain, and several geological studies. Animal parasites, otter behavior, the history of rabies in the area, the characteristics of small mammals in high radiation background areas of Yellowstone Park, and a wide-ranging survey of water resources in the Big Horn Basin are among additional projects under study this year.

This by-no-means-complete listing reflects the characteristic variety of investigations sponsored under the Center banner and their general relevance to National Park management.

One more detailed example is the work on Yellowstone Lake — centerpiece of America's first and best-known National Park. Scientists operating through the Center are conducting research to determine if the lake is undergoing a decline in productivity and ability to support a complex natural food chain. If so, they hope to pinpoint the underlying causes and to offer suggestions for restoring the natural balance if human activity is the cause.

William Romme, a botanist on the faculty of Ft. Lewis College in Durango, Colo., is spearheading the effort in cooperation with NPS and U.S. Fish and Wildlife research biologists. Romme cites "some evidence that the lake's primary productivity has been declining over the past 100 years. Water analyses made periodically since 1884, measuring nutrients critical to algal growth, suggest that some vital elements have reached extremely low concentrations in recent years." He adds it is doubtful that the lake will become completely sterile.

Core samples of the lake bottom sediments comprise a record of diatom



Botanist William H. Romme *demonstrates the use of a device which extracts a small diameter (3/16") core sample in which the annual rings can be counted to determine the tree's age.*

production over the past 1,600 years. Their concentrations in the samples reflect a gradual decline, reaching a very low concentration in the past century.

"It's an enormous lake, very complex. None of these things is conclusive, but taken together they are bothersome," he says.

Romme is proceeding on several fronts and hopes to complete his current investigation by April 1983. His work includes gathering previously developed information from unpublished reports and other widely scattered sources. He also is in contact with Canadian authorities investigating cases in which some of their lakes, like Yellowstone, appear to be declining in productivity rather than becoming more productive with age, as is usually the case.

"We're also looking at several possible factors that may be exerting subtle but potentially profound influences on long-term productivity," he says. "Is it actually happening? If so, is it occurring naturally? These are the real questions, both from an academic and from park management standpoints."

Romme is directing his field work toward the forests of the watershed that drain into the lake. These inflows bring the lake much of its nutrients in amounts that largely determine productivity levels. Young, vigorously growing forest tends to spring up in the wake of fires, and such stands may take up more of the available nutrients than do the older, more stable stands. Following extensive fire, the denuded watershed might yield more of its

Research Facility at Jackson Hole (continued)

nutrients to the lake until such time as new forest growth creates a marked reduction in nutrient yield.

Romme hypothesizes that the 1880's survey may have been made shortly after such a fire and at a time when peak amounts of nutrients were reaching the lake from lightly vegetated watersheds, boosting lake productivity to an unusually high level. If there is a current decline, it may well be part of a natural cycle of nutrient flux, he says.

"In the Yellowstone area, there appears to be a natural fire cycle in which areas as large as 10 square miles are burned over in a short time every 300 to 400 years. Such occurrences could produce enormous pulses in the nutrient cycle," he says.

Romme is working with Dennis H. Knight, UW botany professor, on this aspect of the lake's history and on the larger picture of how old and new forest stands affect nutrient availability in the ecosystem in their varying patterns. He is developing a fire history of the lake watersheds, extracting core samples from living trees and gathering trunk slices throughout the area. These tell him a great deal about the extent of past fires, when they occurred, and how soon the young second growth may have placed nutrient drain on the system.

Romme also is looking at the possible impact of "the removal of more than 3,000 tons of trout from the lake" since it became accessible to human predators — fishermen — over the past 100 years. "That represents a lot of nutrient material lost to the lake ecology and it may have some bearing on the possible reduction of productivity," he notes.

Romme will investigate the vegetation ecology of the area in relation to other information coming to light and will either offer an explanation for the suspected change or suggest additional areas for investigation.

Press releases on most of the research projects — similar to the excerpts from the Yellowstone Lake study — are constantly being prepared by the UW information staff, creating interest and support among the public and informing people about the resources that they, as the public, hold title to.

Diem has been director of the research center since the cooperative agreement between UW and NPS was signed establishing the facility in 1977. UW holds a 15-year special use permit for the site, which is the early-day AMK Ranch, homesteaded in 1890 by John Dudley Sargent and purchased in 1975 by the NPS from its last private owners, the A.C. Berol family of the Eagle Pencil Co. It had served the family as a summer home since 1934, and all the original structures, except those erected by Sargent, still stand.

The buildings, most of them crafted of logs so finely fitted and carefully designed that they are among examples marked for historic preservation, have proved adaptable to scientific research and support activity. The new location was occupied in the summer of 1978, when the activities of UW's forerunner, the Jackson Hole Biological Research Station, were moved to the 120-acre AMK Ranch.

Living quarters accommodate 50 or more well-equipped laboratories, shop buildings, storage areas, and a massive boathouse and dock complete the facilities. The Berol Lodge, a huge log structure on Jackson Lake, encloses labs, two large meeting rooms, the director's office, a three-room researcher's apartment, and a branch of the UW Science Library that has proved invaluable to the operation.

Dominating all are the Tetons, which vault from the far lakeshore 8,000 feet into the western sky. Thousands of tourists pass the approach road daily, unaware of the facility; even most park personnel don't know of its existence. Researchers prize the privacy and commonly spend 12 to 14 hours a day in the field or lab, working right through weekends and holidays.

The investigators pay nominal fees for their accommodations and either cook their own meals or use the Coulter Bay restaurants. They are enthusiastic in their praise of the Center and the situation that permits study in an untouched area beyond the reach of disturbing development (a condition vital to long-term research).

Oak Savanna Habitat Restoration Underway

By Karen Leslie Swirsky and Tim Thomas

In California, native landscape restoration is a fairly new idea. In many cases the landscapes proposed for restoration are so little studied that knowlege of ecosystems operation, species composition, and cyclic events can only be inferred. Facts have been lost forever to development, grazing, cultivation, and other manipulations such as fire suppression.

An example of a quickly disappearing native California landscape is the valley oak savanna. This ecosystem occurs on rich valley bottoms and foothills that also are extremely attractive for agriculture and development. Valley oaks *(Quercus lobata)* are endemic to California, ranging from Mount Shasta to the Santa Monica Mountains.

This is a familiar landscape: majestic oaks up to 30 meters tall and at least twice as wide in canopy, surrounded by seas of meter-high grasses. It is a landscape in real danger of disappearing. Even where development does not remove habitat, the valley oak is largely non-regenerative throughout most of its range.

The major component of the savanna is the grasslands. Native grasses are believed to be composed of largely perennial bunchgrasses and have been replaced over the last century by Europeon grazing-adapted grasses introduced by cattle and sheep ranchers.

The Santa Monica Mountains National Recreation Area includes valley oak savanna at the southern limit of its occurrence, and here a valley oak savanna habitat rehabilitation project has been established. This project takes two directions. The first is a comparison of three valley oak savanna sites. Each site has a different level of disturbance, ranging from severe to moderate. No undisturbed valley oak savannas remain in the Santa Monica Mountains. These three sites are being mapped for vegetation, for comparison between sites and to future mappings.

The second part of the project is to conduct experiments of restoration methods on study plots located on the most severely disturbed site. The problem is how to encourage native grasses, forbs, shrubs, and trees while discouraging the non-natives. A technique may satisfy some of the experimental requirements while violating others. For example, burning is a logical choice for grassland manipulation, having been proven in the field; but a fire will kill valley oak seedlings. Various management approaches will be attempted in a permutuation grid. Within each experimental plot, several "gardening" methods will be used, such as planting nursery propagated grass and oak seedlings, fertilizing, mulching, and excluding animals.

Since this is initially a short-term project, the major applied goals are efforts to determine which management techniques have the best first year results in establishing grassland patterns, and to define the questions for future research. For example: What are the conditions most conducive to healthy valley oak savanna? How much space is required for habitat maintenance? What is the natural density of valley oaks within the savanna? What is the natural seedling mortality for valley oaks? What role does fire play in this ecosystem?

This project will supply information for valley oak savanna requirements, for the management of existing but ailing preserves, and for the establishment of new ones.

Swirsky is in Resource Management and Thomas is in Visitor Services at Santa Monica Mountains NRA.

Oral History Adds Cultural Texture At John Day NM

By Royal G. Jackson

A new program of research whose focus is the cultural history of John Day Fossil Beds NM, has recently been initiated by Supt. Ben Ladd. The world famous fossil beds, located near Dayville in Eastern Oregon's John Day Valley, have long been known and visited by scientists and others interested in the past. The story revealed through these rich paleontological resources is an ancient one that has intrigued many over the years. Indicative of the more recent human history are the livestock industry-associated buildings, structures and implements, which are much in evidence today. They suggest the story of the human use and occupation of this area which is so much better known for its rich fossil remains.

The focus of this research is the Cant Ranch: its relatioship to the Monument's natural and cultural resources, and its representative role as a typical livestock operation in the John Day Valley in the early 1900's. The National Park Service's visitor center and headquarters presently is housed in the original three-story family home of James and Elizabeth Cant, an early Scottish ranching family. The Cant family is important to understanding the history of John Day Fossil Beds NM for two reasons: It was from their holdings that a large portion of the Monument's fossil resources was acquired in the early 1970's; and, their story exemplifies the dominant historical themes of the area's history.

The Cants

In 1905 the young and energetic James Cant arrived to the John Day Valley after spending several years in Argentina raising horses for use in the Boer War. He immediately went to work herding sheep for a fellow countryman from Scotland, Alexander Murray, and began to build up his own band of sheep. In 1907 he sent to Scotland for his boyhood sweetheart, Elizabeth Grant; they married and through hard work were able to acquire, by 1910, the land that became the nucleus of the Cant Ranch.

In ensuing years the Cants prospered in the livestock business, first raising sheep, then shifting their operation to cattle as did most area ranchers. They became a well known and respected family in the sparsely settled area north of Picture Gorge on the John Day River. Their three-story home, which was built in 1917, was an elegant residence for its time; it served as a landmark and hospitable lodging place for weary travellers on the rough road up the John Day Valley.

The Cant Ranch became an established link in the network of ranches that made up the rural ranching community between Dayville and Kimberly. Over the years it was the scene of many social gatherings, resounding to the distinctive and lively bagpipe music that was played for the traditional Scottish dances. The large Scottish community in the John Day Valley provided the stimulus for celebrating cultural activities; the Cant Ranch often provided the place.

In order to educate the four Cant children a school was started on the third floor of their home and children from nearby ranches were invited to attend. A live-in teacher brought from "back east" cheerfully struggled with the three R's; children accustomed to the excitement and constant activity of a working ranch were sometimes not the most receptive to formal education. On numerous occasions the "schoolhouse" was converted to a dance hall and men, women, and children accustomed to long hours of physical labor gave themselves over to dancing, socializing and general merriment.

Although these occasional social events were memorable highpoints and some respite from everyday work, ranch life was dominated far more by work than by leisure. The primary economic activity of the Cant Ranch, livestock raising, provided the rhythm of life just as it did for most rural residents of the area at this time. Lambing, shearing, branding, marking, moving stock to summer range, mending fence, coping with severe weather, and dealing with predators — these were more typical of everyday activities than the occasional social event. A visitor to most ranches would have recognized quickly the din of newly born lambs bawling for their mothers, the easy conversation of the sheepshearing crew members at their noon meal, the clang of metal from the blacksmith shop and the tantalizing baking smells from Elizabeth Cant's busy kitchen. All of these sights, sounds, and smells were typical of rural life in Eastern Oregon during the early decades of the 20th century.

By the time Mr. and Mrs. James Cant had passed away in 1972, the Cants and their ranch had become a part of the local history, leaving indelible marks on the land and its people. In 1975 the National Park Service acquired a part of the family's land holdings and incorporated them into John Day Fossil Beds National Monument.

Oral History as a Research Methodology

The first step in documenting the cultural history of the Monument is being carried out through a methodology little used in the past but gaining greater acceptance — oral history. Oral history is the collecting of any individual's spoken memories of his life, of people he has known, and events he has witnessed or participated in.

Orally communicated historical information can provide supplementary details for topics documented through these traditional means. This is particularly true for past material culture — buildings, work implements, corrals, bridges, roads and other man-made artifacts. Thus, oral history is increasingly being employed to obtain data fro the management of cultural resources on public lands. It also is useful in capturing historical information about changes in the land over time e.g., the condition of the range, prevalence of wildlife, and agricultural practices no longer employed.

A second use of oral sources is to pro-

Typical view *from the window of John Day Valley ranch house around the turn of the century was sheep and their associated out buildings.*

vide complementary information i.e., buttressing the written record through a more intimate and personal viewpoint on well-documented occurrences. Dramatic events such as floods, murders, volcanic eruptions, accidents, epidemics and other life-changing experiences are likely to be recalled in highly personal terms. An example would be recollections of federal government programs during the 30's, in which thousands of sheep were slaughtered, piled and burned. This Depression era measure still evokes vivid and colorful memories among many western stockmen.

Oral history also is useful as a tool to create primary documents i.e., where there are no written records about a given event the oral account may constitute the only original source of information. Information about activities which in some way transgress laws, mores or customs is often difficult to obtain; e.g., deer poaching, "moonshining", cattle rustling, and illicit sex. For the non-literate or those more at ease with oral than written forms, it may be the only way to share historical knowledge.

In summary, oral history is useful to resource managers for: (1) gathering supplementary information about topics already documented through other sources, (2) complementing the written record with information that is more personal and often vividly recalled, thus offering a subjective dimension, and (3) creating primary source material where no previous written record exists. Each of these approaches is being usefully employed in obtaining historical information about the Cant Ranch and its environs.

The Oral History Program at the Cant Ranch

The oral history program was initiated by me during Spring 1982. NPS supplied me with a list of individuals who have first hand knowledge of the topics being investigated: (1) the historical relationship of the Cant Ranch with the Monument's natural and cultural resources, (2) and the Cant Ranch as it exemplifies the livestock industry in the John Day Valley in the early 1900's.

The initial list of potential narrators named 10 people, most of whom were 60 to 75 years of age; two of the Cant's four children were included. Background research on local and regional history was carried out using primary and secondary sources in libraries, archives, museums and private collections. A preliminary interview format was constructed and pilot tested. These tape-recorded interviews provided the basis for additional research, site visits to the study area, and revisions in the question set. The resulting interview format contained about 75 questions that touched all aspects of the topics under study. To date 8 of the 10 informants have been interviewed one or more times, and all tapes have been transcribed on a word processor. In some cases transcripts have been submitted to narrators for revision and additions; ultimately all will complete this process.

Included in the thematic framework of the research are the following: the John Day River as a common thread of rural life; changes in the land over time; stability and change in the livestock industry; rural social life patterns; the Scottish-American subculture; attitudes toward federal land management; influence of the natural and cultural environment on work and leisure; Indian-white relations; transportation and communication; agricultural practice and change; exploitation of the fossil resources; past material culture — cultural resources; and, National Park Service administrative history of the Monument.

Implications for Management

The findings of this research will be useful in carrying out the mandated tasks of planning, managing and interpreting the Monument's resources. Supplementary information is being obtained about the location, age and uses of buildings, corrals, roads, water systems, gardens and other improvements at the Cant Ranch. This data helps the manager better comply with historic preservation laws governing the maintenance, alteration, and removal of cultural resources.

Narrators also are providing complementary historical information. For example, much is known about the construction of the Cant home which is now the visitor center: construction date, materials used, builders' names and other information. Complementing this data are narrators' descriptions of the housewarming, which was well remembered by all who attended as the highpoint of that winter's social season. This information provides insights into the social customs of the day and is useful to the NPS interpretive programs. Some applications could be in slide-tapes, films, written narratives, pamphlets, exhibits, living history programs, and similar media.

The interviews also are producing complementary and primary source information about such topics as the effects of fencing on the open range, relations with the Indians who seasonally migrated through the area, development of major roads and communication patterns, federal land management and the distinctive place of the Scottish-American subculture that flourished in the John Day Valley in an earlier day. This expanded historic data base provides management with better information for decision-making.

The oral history program at John Day Fossil Beds also is enhancing NPS-community linkages. All federal land managers have been called upon to seek greater public involvement in resource management decisions. The knowledge and historical perspectives of long-time residents of the John Day Valley are particularly valuable to NPS employees who often are not from the local area. The oral history program is bringing these narrators into the management process to share their collective historical views, and this in turn, stimulates a cooperative spirit between agency and community.

Jackson is an associate professor in the Department of Resource Recreation Management at Oregon State University.

Letters to the Editor

To the Editor:

Among the many gems in your Winter issue was the final exchange with Supt. Bill Briggle on the role of Park Rangers in resource management and appreciation. Individual specialization and the centralization of talent by Service policy have combined to relocate resource-management skills from uniformed people in the parks to staff people in centers and central offices.

By this statement I do not intend any denigration of the expertise and the necessary role of staff specialists and scientists — in both the natural and cultural resource fields. Rather, I call for a balance. We need discipline-competent people in the resource, people who are part of the park management team in its day-to-day operation. Lacking this balance, people detached from and often totally inexperienced in area operations end up effectively calling the resource-management shots. Often, because of the intimidation fostered by the priesthood of expertise, resident park people — reduced to custodial functions — abdicate their resource-management responsibilities.

I believe that Briggle's comment has germinal import. It ramifies through organizational structures and long-established (if not venerated) personnel policies of the Service. We have left critical posts unmanned in the parks, relying instead on occasional visitations by teams of experts. It does not work. It lacks the synthesis of general and area-specific knowledges.

This subject deserves some concentrated thought. There needs to be a forum established for such thought. Particularly is this true in a time of austerity and institutional stress. As central mechanisms falter, the parks are forced to become more autonomous.

William E. Brown
Regional Historian,
Alaska Regional Office

Information Crossfile

Word comes from Skip Snow, North Unit District Naturalist at Theodore Roosevelt NP, ND, that an article in the January 1983 issue of *American Libraries* "has helped in sorting out where to spend my money." The article is entitled "Microcomputer periodicals for libraries." The author, Karl Beiser, is district consultant for the NE Maine Library District at Bangor and a personal computer enthusiast. His 5-page article amounts to an abstract of general computer periodicals, and periodicals that keep up with library applications of microcomputers. It also contains a listing of specialized and highly technical periodicals in the microcomputing field.

* * *

California's fog is far more polluted than acid rain, according to research described by Leslie Roberts in the November 1982 *BioScience* (Vol. 32 No. 10, pp. 778-9). Roberts tells of research done by environmental enginners at the California Institute of Technology (CIT), showing that fog tends to be "far more acidic than rain . . . often acidic enough to corrode metal." According to Roberts, the CIT research team speculates that "pre-existing smog aerosol forms the seed for the formation of acid fog. Furthermore, SO^2 and NO_x are converted to sulfuric and nitric acids within the fog droplets."

The Nov. 12, 1981 issue of *Science* (pp. 677-9) carries a technical description of the findings — "Chemical composition of Acid Fog" — authored by Prof. Michael R. Hoffmann and the CIT students who ran the study with him. The work was done from the W.M. Keck Laboratories at CIT, Pasadena, CA 91125. The pH of the fog water was reported to range from 2.2 to 4.0.

* * *

A condensed but highly inclusive article, "The Acid Precipitation Phenomenon and Its Ecological Consequences," by Ellis B. Cowling and Rick A. Linthurst in the October 1981 *BioScience* (pp. 649-53) contains a section of summary statements describing the general status of knowledge about acid precipitation and its ecological consequences as of December 1980. They are synthesis of observations and inferences derived from "many independent investigations," and abbreviated from the more complete and referenced statements by E.B. Cowling in a 1981 research report entitled "An historical resume of progress in scientific and public understanding of acid precipitation and its biological consequences." As of October 1981, the Cowling report was in press.

* * *

The January 1983 issue of *Discover* describes genetic engineering in 1982 to create bacteria useful in industrial processes. Those engineered by a microbiologist at the University of Illinois may soon be separating petroleum into useful components. One strain will be field tested to determine how well it can digest waxes and paraffins, leaving behind only commercially profitable light crude oil. Another strain developed there in 1982 thrives on sulfur compounds in high-sulfur oil, converting them to water-soluble sulfates that can easily be removed so the oil will burn more cleanly. The University College, Cardiff, in Wales, reported that two naturally occurring species of thiobacillus bacteria could be used to remove silver from sulfide ore minerals and accumulate it on their surfaces. Even further out is the news from the Tokyo Institute of Technology, where a bacterium was reportedly used in the generation of electric power. The bacterium digests glucose to produce hydrogen, in a polymer gel laced with molasses. The hydrogen thus produced was fed to a hydrogen-oxygen fuel cell (of type used in the space shuttle) to generate electricity.

* * *

A fairly new entry into the field of management, maintenance and design publications is *Parks and Recreation Resources*, an international magazine for managers of parks, recreation areas, resorts, grounds, golf courses, waterways and zoos. Vol. 1, Nos. 9 and 10 (September-/October 1982) carries an article, "American Photographers and the National Parks," by Robert G. Ketchum, describing the traveling exhibit of the same name that opened in Minneapolis in October 1982, moved to the Denver Art Museum in January 1983, and will wind up in Los Angeles at the County Museum of Art April 7 through June 26. Ketchum traces the historic impact of photography upon the National Park idea, which he calls "one of the very finest of the ideas that have risen from the American consciousness." The younger photographers whose work is being shown "offer clear evidence," according to Ketchum, "that the first circle of thought has been completed and that we stand on the threshold of new ideas. The work of these artists has been fed by the parks, rather than feeding them, and it shows that the parks are a resource of great intellectual breadth, as well as recreational playgrounds."

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* * *

The February 1983 issue of *Oregon Wildwife* carries news of "understandable embarrassment" in Idaho when the state's 1982 fishing regulations came out with an ad encouraging sportsmen to donate money to the state's nongame "wildlife fund." To this typographical error was added the slogan "Do something wild in 1982." A Lewiston, Ida. sports shop owner was so taken with the goof that he had 500 T-shirts printed proclaiming Idaho's "Wildwife Program." The first 350 shirts were gone in one week; $250 profit from the sales went to Idaho's nongame program.

* * *

Australian Ranger Bulletin is the same name of the Australian National Parks and Wildlife Service bulletin published twice a year in Canberra City (Box 636, PO Canberra City, ACT 2601 Australia). Established in 1981 "to provide a forum for training, communication and idea sharing on a national level by and for rangers on parks and wildlife," the bulletin is a handsome, illustrated, approximately 40-page publication that covers a wide variety of management subjects in a breezy, conversational style. One issue (Vol. 1 No. 2) discusses the organism causing blindness in wallabies — toxoplasmosis, with "one of the most frighteningly versatile life cycles known." In the same issue the effects of feral animals (pigs, goats and rabbits, introduced in 1790) on islands in Botany Bay are examined and plant regeneration work is described. "Planning and Development: Adhocism vs. a Systems Approach" discusses real life problems in Australian parks resulting from failure to recognize the "components" and "linkages" in management actions and the consequences that could have been anticipated.

* * *

Western Forester (1326 American Bank Bldg., Portland, OR 97205) in its February 1983 issue, carries an editorial by Bob Ethington and Sarah Greene in defense of the USFS Research Natural Areas. "We argue," they write, "that unless our only objective is short-term availability of forest resources, the completed system of Research Natural Areas is vital to all resource managers." Greene is a research forester and Ethington is Director of the Pacific Northwest Forest and Range Experiment Station in Portland, (809 N.E. Sixth Ave.), OR 97232.

* * *

The first application in Alaska of the Recreation Opportunity Spectrum (ROS) — in the White Mountains National Recreation Area — is described by Richard B. Tobin, BLM outdoor recreation planner from Fairbanks, in the January 1983 issue of *Agroborealis*. The full color publication of the USDA Agricultural Experiment Station at the University of Alaska, Fairbanks 99701, also contains an article by Glenn P. Juday describing an exploration of one of five potential Research Natural Areas within the 2.2 million acres that comprise the White Mountains NRA and the Steese National Conservation Area. Although it has been overshadowed in attention by the NPS and National Wildlife Refuge Systems, the White Mountains recreation opportunities rival those found anywhere in Alaska, according to Tobin.

Study Documents Plant Poaching In Great Smokies

By Susan Power Bratton

National Park Service managers frequently complain about people who trample, pick or dig up showy wildflowers and rare plants. Desert parks report difficulties with cactus fanciers who check out the park during the day, then sneak out into the desert at night and remove unusual or especially attractive species of cacti. The sub-tropical parks, such as Everglades, find orchid enthusiasts can not resist removing epiphytic orchids and other "air plants". In many cases, a park may have both amateur plant poachers, (the people who dig plants for their own home gardens or casually pick a few flowers), and the professional poachers, (those who gather large numbers of plants for sale).

In the Great Smoky Mountains NP, plant poachers are known to harvest medicinal plants, especially ginseng *(Panax quinquefolium)*, an herb supposed to increase one's life span and virility. Poachers also dig up showy flowering plants, such as azaleas, rhododendrons, and orchids, and strip off moss mats that can be used to decorate terrariums. Some species can be sold to dealers who specialize in wild plants. Dried ginseng root will bring up to $140 a pound, azaleas a few dollars each, and woodland orchids a dollar or two for each flowering shoot.

Since some endangered species may be subject to poaching, and poachers may be harming the experience of park visitors by removing the best populations of showy flowering species, plant poaching has received increasing attention as a resources management and law enforcement concern.

Unfortunately most of the information on plant poaching is anecdotal. Rare plant monitoring is a relatively new activity in most parks, so long term data on possible population declines, due to poaching and other factors, are uncommon. Poaching is difficult to study because poachers usually know what they are doing is against the law and try to avoid being seen. Since one or two diggers can remove over a hundred shoots of an herbaceous plant in a few hours, a very low number of poaching incidents could greatly deplete a local population of plants. Once the plants have disappeared, there is no way of to quantify population changes and poaching impacts.

In Great Smoky Mountains NP, two projects are attempting to determine the magnitude of the poaching problem. First, Peter White, of Uplands Field Research Library in the Great Smokies has been cooperating with Rob Sutter from the North Carolina Department of Agriculture, Pesticides and Plant Protection Division, in establishing a ginseng monitoring program. The original idea was to find "pristine" or "undisturbed" populations in the park to use as controls for populations outside the park. Due to the large percentage of small or immature plants, however, it is now thought even Smokies ginseng populations several miles from the nearest trail are subject to at least some digging. The plant is so valued by poachers that it almost never is seen near park roads or trails, even where there is good habitat.

The ginseng monitoring was initiated by locating populations in remote watersheds, including "virgin" forest, then marking each study site with metal stakes and aluminum tree tags. The investigators sample a strip heading upslope. Individual shoots are censused, the number of "prongs" (leaves) is counted, and the presence and number of flowers is recorded. Botanists can return late to these sites and determine if the populations are increasing or decreasing and if their structure has changed.

The second project was a field survey of two species of woodland orchids known to be favored by wildflower gardeners. One of the species, showy orchis *(Orchis spectabilis)*, occurs at scattered locations in low elevation stream valleys. A small plant, usually less than eight inches tall, it produces sprays of delicate lavender and white flowers from mid-April to early May. The second species, pink lady slipper *(Cypripedium acaule)*, prefers pine and oak forests. Often over a foot tall and easy to locate, it produces a single large pink flower from late April to early June.

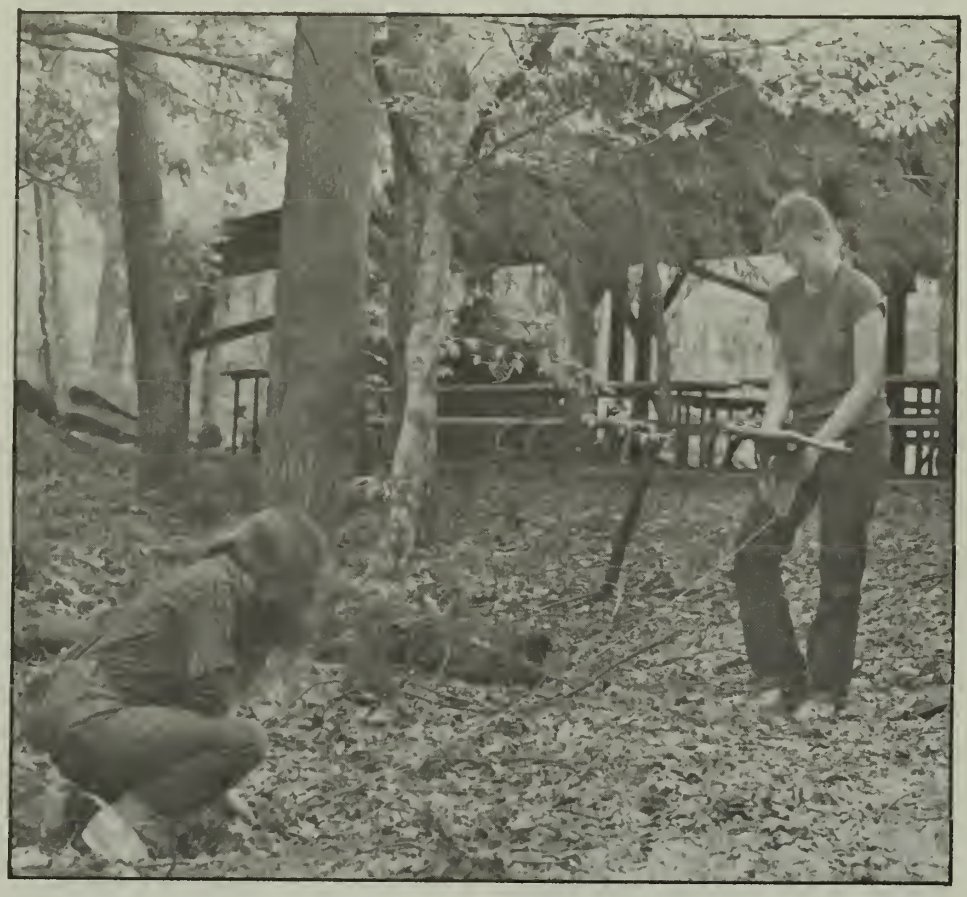
Showy orchis, *a small, spring, forest floor herb known to be harvested by wildflower gardeners in the Great Smoky Mountains NP.*

Research teams, including volunteers from EARTHWATCH sampled orchid populations in four types of areas: 1) vehicular access or very easy access, such as nature trails, 2) moderate access, foot and horse trails, 3) difficult access, trails more than 5 km from the nearest vehicle road, and 4) cross-country access, site without maintained trails.

The teams sampled a 50 m wide swath along a road or trail (or in the case of cross-country routes along a stream or ridge line) and attempted to locate all the orchids over a distance of 1 km or more. Each team recorded a series of environmental variables, such as slope and forest type, both every 200 m and every time they encountered a new population of orchids. For each individual shoot the investigators recorded length of longest leaf, number of leaves per shoot, presence or absence of flowers, distance from nearest automobile road, distance from nearest trail, and visibility from nearest road or trail. Information also was collected on distance to the next nearest shoot of the same species.

Preliminary data analysis has shown, first, that the showy orchis responds favorably to disturbances along roads and trails. Along routes most heavily used by visitors, 1245 showy orchis plants were found within 0 to 9 m of the trail edge, 983 from 10 to 19 m, and only 362 from 40 to 49 m. The percentage of plants blooming was only slightly higher for the distant individuals: 26 percent of the plants 40 m or more away from the trail were blooming as opposed to 23 percent of the plants within 0 to 9 m of the trail. Further, the population structure in the high visitor access sites was very similar to that in the remote off-trail populations. The mean length of the longest leaf for the high access was 7.49 cm, while it was 7.46 cm for the off-trail samples. The average percentage of plants blooming along easy access trails was 25 percent, 21 percent for remote areas. There was thus very little evidence that plant poaching or the presence of developments such as trails was harming the populations of this species.

The pink lady slipper situation was quite different. Lady slipper populations along automobile roads and nature trails had smaller plants and fewer flowering individuals than those in remote, backcountry areas. The average length of the longest leaf was 7.29 cm, 10.57 cm, 11.08 cm and 14.61 cm for vehicle roads, nature trails, moderate access sites and remote sites respectively. The percentage of plants with flowers was only 3 to 4 percent for the roads and nature trails, while it was 11 percent for moderate access, and 24 percent for remote sites. Ironically, in one of the most heavily visited areas of the Smokies, Cades Cove Loop Road, over 1200 lady slipper shoots were located with in 50 m of the road, but only 3 of these plants were found to be blooming. (Over grazing by deer may be contributing to the small



EARTHWATCH volunteers *taking basic environmental measurements and determining the distance to the nearest road and trail for population of showy orchis growing in a park picnic area.*

size and lack of mature orchids, in this case). The three nature trails sampled had 347 plants total, about 10 of which were blooming. The data showed that only the larger lady slippers bloomed, and that once the plants reached about 26 cm leaf length, they almost always bloomed. If poachers were removing primarily flowering individuals they also would be removing the largest plants, perhaps accounting for the smaller size of the orchids in the high use areas. Grazing or trampling could also, by reducing leaf size and plant productivity, inhibit blooming.

Although there are still numerous healthy lady slipper populations in the Great Smoky Mountains NP, and the existence of the species is not critically threatened by human activities, densely flowering populations of lady slippers are not present in sites with easy visitor access. Since lady slippers have a favorable response to disturbances, such as canopy opening, there is little reason to believe the presence of roads and trails is causing difficulties. These openings appear in some cases to stimulate the populations. It is more likely that direct disturbance by people, including digging, flower picking and trampling while viewing flowers is depleting the number of blooming plants. Evidence of digging was noted during this survey.

The data indicate that plant poaching should be a concern for park management in the Great Smokies, but that further information is needed. Monitoring of ginseng and of lady slippers should continue and park botanists should attempt to determine if any other species populations are presently subject to significant impact. Yellow lady slippers, which are much rarer in the park than the pink, should certainly be censused and monitored as should all the threatened or endangered orchids and lilies. Law enforcement and interpretive staff can assist in the effort by providing data on poaching incidents and by making visitors more aware of the damage caused by poaching.

Bratton is a research biologist with the NPS/CPSU at the University of Georgia's Institute of Ecology.

Measuring the length *of the longest leaf of a pink lady slipper. Aside from counting individual plants in the sampling areas, as series of morphological measures were taken including number of leaves, length of longest leaf, presence of flowers, and distance to the next nearest plant of the same species.*

A road side *in Great Smokies. Such sites are good wildflower habitat, but are heavily used by visitors and are easily accessible to plant poachers.*

Bear Research Scientists Hold 6th World Meeting

By David M. Graber

Some of us wondered if we could pull it off one more time. How much attention could one small family of mammals possibly command, particularly after some 15 years of intensive research, headline-making management and conservation issues, and 5 international conferences. We had nothing to worry about. After 4 exciting/grueling days of paper presentations, workshops, poster sessions, special sessions, rump sessions, and block-the-hallway sessions, the Sixth International Conference on Bear Research and Management had marked a professional turning point for an organization and a renewed awareness that the study and concern for Ursidae is more urgent than ever.

The small group of biologists that had met in Whitehorse, Yukon, in 1968 to talk about bears; had defined itself in Calgary, Alberta in 1970 and Binghamton, N.Y. in 1974; had grown and formalized itself as the Bear Biology Association in Kalispell, Mont., in 1977 and Madison, Wis., in 1980, was at last a fully mature organization by the time the Grand Canyon, Ariz., rolled around in 1983. In recognition not only of its long-standing representation of Canadian members, but of increasing participation by members working in Asia, Europe, South America, and Mexico, BBA renamed itself the "International Association for Bear Research and Management," (abbreviated acronym: IBA).

Because the study of bears has traditionally been tied to management concerns — bears' roles as pests or threats on one hand and as a diminishing resource on the other — IBA membership and attendence at conferences has always leaned heavily to public resource managers and the biologists who feed them information. That old complaint by managers that the information given them is irrelevant to mangement or incomprehensible was never uttered (at least in the presence of this reporter) at Grand Canyon.

On the contrary, a significant change was the inclusion of some fascinating new work on the physiology of hibernation and the blood changes associated with pregnancy. Zoo workers presented papers on captive sloth bears *(Melursus ursinus)* and spectacled bears *(Tremarctos ornatus)*, species little known from field investigation. A pair of Spanish papers and their accompanying film looked at brown bear *(Ursus arctos)* behavior essentially unknown in this intensely-studied species in the wild.

If there was one topic of exceptional interest, it was concern for the welfare of the Yellowstone grizzly bear *(Ursus arctos horribilis)* population, and continued survival of remnant populations in the Selkirk Mountains, the Selway-Bitterroot Mountains, the North Cascades, and the Cabinet-Yaak Mountains. Recent population trend evidence suggests a continued decline in numbers, while there have been an alarming number of known and suspected mortalities by illegal taking in lands surrounding Yellowstone National Park. Richard Knight, NPS scientist and Yellowstone Interagency Study Team Leader, did not attend, but Chris Servheen of the Fish & Wildlife Service reviewed research and management programs.

Concern for the lack of quality census data was a recurring theme, as Dale McCullough (U/Cal), Harold Picton (MT/S/U), presented different population models linking population dynamics to climate, food availability, and age/sex composition of the population. McCullough electrified the gathering by proposing, at the conclusion of his technical paper, a simplified management scheme in which bears in the Yellowstone ecosystem would be censused each year by a direct aerial count; which would establish a known minimum number of animals. Whenever that minimum count yielded a number below some predetermined acceptable number, emergency intervention measures would automatically begin.

Actions that have been discussed include the elimination of timber harvests, stock allotments, and all hunting (grizzly bears are, of course, protected from hunting but not from depredation and "self-defense" kills) in the lands surrounding the Park, and artificial carrion feeding at remote sites within the Park. The former actions would presumably reduce the number of mortalities, while feeding would increase fertility, and concentrate bears inside the Park but away from visitors.

McCullough observed that with his system, there would be a strong motivation for National Forest users *not* to kill grizzlies, since a reduced count could jeopardize their operations. The McCullough plan circumvents the present stumbling block that dependable and consistent population figures have not been produced for the past decade; almost invariably population modelers have had to rely on data collected by the Craighead team during the 1960s.

Polar bears were represented not only by some of the finest technical papers of the conference, but also by a meeting of the Internation Union for the Conservation of Nature and Natural Resources (IUCN) Survival Service Commission: Polar Bear Specialist Group. Representatives of the 5 nations with polar bear populations meet regularly to discuss conservation and management of this animal on an international basis. Thor Larsen, of Norway, presented a spectacular Norwegian film on the polar bear. In one cooperative venture among American, Canadian, and Norwegian scientist, polar bears were fitted with radio transmitters and then tracked by satellite as they moved with the ice floes.

One arresting commonality of several of the 50-odd papers was how loss of fertile lowland habitat — in Alaska, in Italy, in Canada, in Peru, and in China — to human development had restricted bear to inferior montane habitat and set the stage of bear-human conflicts in which bears always are the ultimate losers. Bernard Peyton, who has been studying the virtually unknown and rapidly disappearing spectacled bear of the Andes, revealed in graphic detail how burgeoning human populations are creeping up the mountain, replacing native forest with corn fields.

George Schaller, project leader of the international giant panda (*Ailuropoda melanoleuca*) research project in China, was at Grand Canyon to find out if the biology of bears may shed light on their mysterious cousin. Schaller's fascinating presentation of the research and conservation problems of the giant panda revealed once more how loss of bottomland to human agriculture had placed the pandas in montane habitat rendered unstable by the bloom-and-die cycles of the bamboo food resource.

Your reporter led a workshop entitled "The Impact of Biologists on Bears," designed to explore the dual phenomena of (1) ways in which research activities modify the ecology or behavior of bears, thus producing spurious results, and (2) ethical responsibilities toward our study subjects since some common procedures — capture, sedation, radio-collars, den visits, tooth extractions — clearly impose some costs on the animals. Participation by an appointed panel and by the conferees as a whole was animated and intense. There was a general feeling that our profession-specialty had matured to the point where a code of ethics and guides to minimize trauma to study subjects were appropriate responsibilities of the IBA.

There was a common thread of concern for the welfare of bears outside North America and Europe. Charles Jonkel (U/MT) is chairman of the IUCN-SSC Bear Specialist Group; he held several sessions discussing ways in which IBA and its members could accelerate the study and protection of spectacled bears, sloth bears, sun bears (*Helarctos malayanus*), Asiatic black bear (*Ursus thibetanus*), and several races of brown bears (*U. arctos*) where their future existence is in jeopardy.

One thing seemed certain at Grand Canyon: the future survival of research and interest in bears is not now threatened.

Graber is a research scientist at Sequoia and Kings Canyon NP and served as IBA Conference Prodeedings Editor.

Colorado Tick Fever In Rocky Mountain NP

Editor's Note: The management implications stemming from a recent study, by U.S. Forest Service scientist Andrew B. Carey, are so well presented and follow so logically from the research, that Dr. Carey's presentation (somewhat different from ***Park Science*** *style) are here set forth as submitted.*

By Andrew B. Carey

The Disease: Colorado tick fever (CTF; historically referred to as "mountain fever" or "American mountain fever") is a viral disease acquired through the bite of a tick. The disease may be mild and go unnoticed but usually has an abrupt onset three to six days after a tick bite, with symptoms being chilly sensations, high fever, severe headache, sensitivity to light, lethargy, and muscle-ache. The fever lasts two to three days, subsides for one or two days, and then recurs for two or three days. In rare cases, primarily in children, the disease may be worse, with encephalitis or bleeding. A rash may develop and the disease is often misdiagnosed as Rocky Mountain spotted fever (a bacterial tick-borne disease).

Diagnosis: Tick bite and symptoms may suggest CTF, but confirmation rests on isolation of the virus from the blood by inoculating red blood cells into newborn mice or tissue culture. If the mice or the cells die, fluorescent antibody staining is used to identify the virus. Tests for antibody specific to CTF may be used also.

Treatment: There is no specific treatment; in other words "take two aspirin and go to bed." Rest, general supportive care, and medicine to reduce fever and pain generally serve to ameliorate the symptoms. Recovery is usually rapid.

Causative Agent: CTF is caused by a virus in the genus *Orbivirus*. A related virus *(Eyach)* has been found in ticks in Europe. CTF virus infects red blood cells, where it is protected from antibody and other body-defense mechanisms. CTF virus is unrelated to the rickettsia that causes Rocky Mountain spotted fever.

Vector: CTF virus is carried and transmitted primarily by the Rocky Mountain wood tick *(Dermacentor andersoni)*. The wood tick also transmits Rocky Mountain spotted fever and causes a disease called "tick paralysis."

The wood tick has four stages in its life cycle: egg, larvae, nymph, adult. The tick increases in size with each stage. Each stage feeds once. Males feed lightly until they are attracted to a feeding female by her chemical signals. Males impregnate the partially engorged, feeding females. Larvae, nymphs, and females feed until they are engorged with blood. After feeding, these ticks drop off the host and seek shelter. The larvae molt to nymphs; nymphs molt to adults; females lay eggs and die. Each stage feeds on successively larger mammals; for example, larvae feed on mice *(Peromyscus)* and chipmunks *(Eutamias)*, nymphs on chipmunks and ground squirrels *(Spermophilus)*, and adults on porcupines *(Erethizon dorsatum)*.

Distribution: People become infected with CTF virus throughout the mountainous regions of the western United States and Canada. Distribution of the disease is correlated with that of the wood tick, however it is certain the virus occurs outside the range of the wood tick. Eight other species of ticks have been found infected with the virus. The actual incidence of the disease is unknown because the disease frequently is misdiagnosed and underreported. Colorado reported 77 percent of the 1,767 cases reported during 1956-1965. During 1970-1977, Colorado reported an average of 174 cases/year. A large proportion (46 percent) of these cases were in the two-county area encompassing Rocky Mountain NP. An independent study by the Vector-borne Diseases Division of the Centers for Disease Control (CDC, U.S. Public Health Service) estimated that as many as 391 cases of CTF may have been contracted in one campground in Rocky Mountain NP in one year. The risk of infection was calculated to be 1 case/346 camper-days.

Natural Cycles of Infection: Nymphal wood ticks carry the virus through the winter and infect small mammals the next summer; the small mammals then infect larval wood ticks, which molt to nymphs and carry the virus through the winter. Thus, circulation of the virus is maintained among the larvae, nymphs, and small

Larval wood tick is shown (above) at the end of a jeweler's forceps, being removed from a deer mouse — the same genus as the white-footed mouse. In the photo below, Carey draws blood efficiently and harmlessly from a deer mouse's post-orbital capillary. Both methods were used in Carey's studies *Ixodes dammini* (vector of Lyme disease) and *Dermacentor andersoni* (vector of Colorado tick fever.)

mammals. Nymphs become adults, and although adults are a "dead-end" for the virus because they feed on larger hosts than the nymphs and larvae, it is the adults that transmit the virus to humans.

Research In Rocky Mountain National Park: The CDC, under the direction of Bob McLean, began an investigation of the CTF natural cycle in Rocky Mountain NP in 1974. The first step was to determine where the virus and ticks occurred altitudinally. Small mammals were trapped at sites 8,000 to 11,400 feet in elevation. McLean found that the least chipmunk *(E. minimus)* and the golden-mantled ground squirrel *(S. lateralis)* were the most frequently infected small mammals and that they had the greatest infestations of immature wood ticks. It also was apparent that the ticks were most abundant at the lower elevations (the upper montane zone) and on rocky, south-facing slopes.

Armed with this knowledge, the CDC launched an investigation to determine more precisely where the natural cycle was maintained and, more importantly, why the cycle was localized in the landscape. Two study areas were chosen to encompass all the plant communities found on south-facing slopes in the upper montane region of the Park.

Intensive studies of flora, fauna, and environmental structure over a two-year period developed a clear picture of the CTF cycle in the Park. The south-facing slopes in the upper montane were characterized by major ecological gradients of soil depth and soil moisture. Wood ticks were confined to areas of shallow soil, steep slope, exposed rock, and rock crevices by their physiological tolerances for soil temperature and soil moisture. Solar radiation must be great enough to warm the soil sufficiently for egg development in the summer. The warm period of summer must be long enough for larvae and nymphs to emerge, find a host, feed, and molt before winter. But, winter soil temperatures must be sufficiently cold to physiologically release the adults from the diapause that prevents them from feeding in the fall. These low soil temperatures also prevent the immature ticks from attempting to feed at the wrong time of the year. Soil relative humidities must be high enough to prevent desiccation of eggs and ticks. Thus, suitable conditions for tick survival depend on latitude, altitude, aspect, vegetative cover, and litter.

Another requirement of the ticks must be met — they must have hosts to feed upon. Golden-mantled ground squirrels, least chipmunks, and porcupines were abundant on the rocky slopes, where they found all their requisite food and cover. The influence of environmental structure was so pervasive that equations (discriminant functions) could be developed to predict where the ticks and virus occurred. These equations were based on easily measured environmental variables such as soil depth, amount of shallow soil (less than two inches), degree of slope, shrub cover, and amount of grass litter. Unfortunately, research funds were too limited to evaluate these equations in new areas and only a statistical validation was performed.

Applicability of the Research: The descriptions of the environment amenable to virus and ticks (and the discriminant functions if they were fully validated) could be used to locate recreational facilities and activities to minimize human exposure to the virus. The tick discriminate function could be used in the application of acaricides (pesticides).

The research provided information on other problems. For example, Richardson's ground squirrel is a reservoir for plague *(Yersinia pestis)*. Results of the study suggested that if Richardson's ground squirrels were controlled (killed) to minimize human exposure to plague in Moraine Park Campground (such an effort was instituted in 1976 and 1977), they would be replaced by golden-mantled ground squirrels, a major carrier of CTF. However, this would not increase the risk of human exposure to CTF virus because the golden-mantled ground squirrels would have moved out of the area that was climatically suited for ticks.

Prevention of CTF: CTF is best prevented by being aware of the danger posed by the adult ticks. In Rocky Mountain NP, adult ticks are most active during May and June and are most abundant on rocky, south-facing slopes between 7,900 and 8,900 feet. People should be encouraged to avoid spending too much time in these areas in the spring. Also, people should be encouraged to assist one another in detecting and removing ticks from their clothing and bodies. Light-colored clothing make the dark ticks more apparent. "Blousing," or tucking pant legs into boots or socks, prevents the ticks from quickly becoming concealed beneath the trousers. Personal examination after a hike or other recreational activity (concentrating on the groin, belt line, and hair line on the neck — ticks respond to tight places in determining where to feed) can often detect ticks before they complete attachment and begin to feed.

Further Information: More detail on CTF in Rocky Mountain NP can be found in the following reports: Carey, A.B. 1979. Discriminant analysis: a method of identifying foci of vector-borne diseases. American Journal of Tropical Medicine and Hygiene 28 (4): 750-755; Carey et al. 1980. The structure of a Colorado tick fever ecosystem. Ecological Monographs 50 (2) :131-151; and McLean et al. 1981. The ecology of Colorado tick fever in Rocky Mountain National Park in 1974. American Journal of Tropical Medicine and Hygiene 30(2): 483-489.

NEW TICK DISEASE HITS FIRE ISLAND

By Jean Matthews, Editor

A new human affliction, dubbed Lyme disease in "honor" of the Connecticut town where it first achieved notoriety, is moving down the Eastern seaboard and causing consternation at such parks as Fire Island NS and Gateway NRA, according to personnel from both National Park areas.

The causative organism appears to be a spirochete, transmitted by *Ixodes dammini*, known as the northern deer tick. Initial sign of the disease is a red ring around the bite, differing from ordinary insect bites by a continued expansion over a period of several days — up to a foot or more in diameter. In the early stages, victims are subject to a variety of symptoms in several combinations, including headache, nausea, stiffness in the neck, and fever. Some people report arthritis-like pain in the joints, flaring and waning intermittently over several years.

Len Bobinchock, Fire Island resource management specialist, reports that science has been following the disease only since 1976, so very little is known yet about either its history or its prognosis. Bobinchock has made a study of articles appearing in medical journals and has presented his report to East Coast park personnel.

The northern deer tick hosts, in the immature (larval and nymphal) stages, on small mammals such as the white-footed mouse. In the adult stage, the tick prefers larger animals such as the white-tailed deer. Anywhere along the line of progression the tick will host on humans if they become available. From present research, it appears that both the nymphal and adult stages may transmit the disease-causing spirochete.

Several staff people at Fire Island have contracted the disease, as have many of the approximately 20,000 persons who reside in the summertime within Fire Island National Seashore. Bobinchock reports that pressure is mounting from residents who want the park "to get rid of" the deer and white-footed mice.

"We view this approach as overly drastic," Bobinchock said, adding that Supt. Jack Hauptman has been working closely with New York State Department of Health authorities, who agree that attempts to exterminate the deer and mouse carriers might well increase the likelihood of the ticks' attacking more humans.

Preventive measures are preferred at this stage, according to Bobinchock, who is following the literature and working with local health officials to find effective means for containing the disease.

REGIONAL HIGHLIGHTS

PACIFIC NORTHWEST REGION

An interagency, multidisciplinary research effort, the Old Growth Wildlife Habitat Research and Development Program, has set up an OGWHP Information Exchange. Research Coordinator Andrew B. Carey announced this means of promoting rapid exchange of newly developed information — inciting researchers to maintain a steady flow of information to the Program in exchange for a return flow of information. The first packet contained a summary of on-going spotted owl research and an up-to-date chronology of Program developments. The research listing, by agencies, includes three NPS studies: fire history in Olympic NP by Jim Agee, University of Washington CPSU; ungulates in old-growth forest in Olympic NP by Ed Starkey, Oregon State University CPSU; and fishery studies in Olympic NP by Doug Houston, PNR research biologist.

* * *

The following publications became available in the past quarter: "Management of Roosevelt Elk Habitat and Harvest," E.E. Starkey, D.S. deCalesta and G.W. Witmer, reprinted from *Transactions* of the 47th North American Wildlife and Natural Resources Conference, 1982; "Social Organizatiton of Roosevelt Elk in an Old-Growth Forest," Kurt J. Jenkins and Edward E. Starkey, reprint from *Journal of Mammalogy*, Vol. 63, No. 2, May 1982; and "Problems of Natural Resource Management at Small Historic Sites," by R. Gerald Wright, as published in *Parks*, Vol. 7, No. 3, Oct-Dec., 1982.

* * *

Annual Reports for 1982 from all three CPSU's in the PNR are now available; the addresses are University of Washington, Seattle 98195; University of Idaho, Moscow 83843; and Oregon State University, Corvallis 97331. An addition, the U/ID CPSU has published "A Survey of Unauthorized Roads in the Coulee Dam NRA," by Gerry Shimek.

* * *

The October, November, December 1982 issue of *Parks* carries a 3-page article by R. Gerald Wright, biology project leader of the University of Idaho CPSU, entitled "Problems of Natural Resource Management at Small Historic Sites." Management problems at such sites are examined from both the historic and the current perspectives, using three characteristic sites as study examples: Whitman Mission NHS, Walla Walla, WA; Nez Perce NHS, Spalding, ID, and the Fort Spokane area of Coulee Dam NRA, near Davenport, WA.

ROCKY MOUNTAIN REGION

Richard W. Klukas, research biologist at Wind Cave NP, reports on-going experiments with prescribed fire in an effort to reintroduce the burning that was a natural part of the ecosystem in the past and to determine its effects on birds and small mammals.

Initial reason for the burn was to protect the park's grasslands from pine encroachment and provide more room and food for buffalo. The burning had caused bird population to decrease - especially the grasshopper sparrow, while population of small mammals has increased. Klukas said the bird population is expected to rebound within two or three years, but research into this matter will continue. The increase in prairie deer mice, 13-lined ground squirrels, and prairie voles seems to be due to increase in food supply. The fire burns old grass, releasing nutrients into the soil and providing more grass and seed for the small mammals, Klukas said.

Research is being conducted with graduate students from Michigan Technological University's forestry department.

MIDWEST REGION

Apostle Islands National Lakeshore hosted its 4th Annual Research Conference on Oct. 29, 1982, in the Headquarters/Visitor Center Auditorium, Bayfield, Wisc. Topics ranged from birds and bears to shipwrecks and logging camps as researchers from nearly a dozen area agencies and universities gathered to report on their past year's work at the Lakeshore.

The meeting is held annually as a regional information exchange. It provides opportunity to learn about the natural and cultural resources of the area as well as some of the management approaches and projects currently being carried out within the Lakeshore.

This year's program included basic ecological inventories, electro-fishing surveys, floral and faunal habitat studies, water resources and wildlife management, and several historical research projects. The Park Superintendent and representatives from the Midwest Regional Office in Omaha keynoted the program with a look at the role of research in NPS planning and programs.

WASO

At the request of the Western Regional office, WASO has completed an Interagency Agreement with the U.S. Soil Conservation Service relative to making soil surveys on lands administered by NPS. This joint umbrella agreement enables any Region or Park to approach the local SCS office for soil survey work needed.

Alaska Region

This Last Treasure: Alaska National Parklands is the name of a 128-page, full color, album-size book just published by the Alaska Natural History Association, 540 West Fifth Ave., Anchorage, AK 99501.

A veritable treasure itself, the book abounds in great quotes from sensitive observers and writers whose personal impressions span two centuries. NPS Writer William E. Brown, with talent and taste, has assembled and spun these quotes into a seamless whole, reflecting almost every facet of the enormous complexity that is Alaska — natural and cultural.

The soft cover edition sells for $10.95 plus $2.00 for handling and postage; hard cover books are $25, with an additional $4 for mailing.

* * *

The first Glacier Bay Science Symposium, "A Century After Muir: The Scientific Adventure," will be held Sept. 23-25, 1983, at Glacier Bay Lodge in the Park. Cosponsored by the Park and Friends of Glacier Bay NP, the conference will bring together past and present researchers for an intensive interdisciplinary look at research needs for the future. Interrelationships — affecting every component of the park from plant succession, the marine system, and glaciology to fauna and climate — will be the thread tying together the findings and directing the look toward tomorrow's projects. Publication of the Conference Proceedings is planned.

Mid-Atlantic Region

A virtually unstudied bird, the vultures of Gettysburg National Military Park are finally getting their scientific picture taken. The study effort involves the National Park Service, Pennsylvania State University, the U.S. Fish and Wildlife Service, the Virginia Polytechnic Institute, the University of Blacksburg, Va., and the Eastern National Parks and Monuments Association. The latter contributed $7,000 to the study.

Interpretation at the Park describes the battle carnage that originally drew vultures to the scene. Current studies of the black and turkey vultures, now an institution at the site, aim at determining the winter and summer ecology of the birds —why they continue to use the park. Tony Wright, a wildlife management major at PSU, is heading the study as part of his graduate work. Hal Greenlee, natural resource management specialist at Gettysburg NMP, calls the relationship between the vultures' presence and the 1863 Battle of Gettysburg "still speculative," but notes that it would be reasonable to assume that vultures would have come to the site if the animals killed there were left unburied.

* * *

Four new publications now available from MAR's Division of Natural Sciences are: "Rare and Endangered Plant Species Within the New Jersey Portion of the Delaware Water Gap NRA," "Trees for Urban Parks: A Guide for Selection and Culture of Trees in Northeastern Cities," "Interpretation of the Landscape in Independence NHP," and "Population Characteristics, Habitat Utilization, and Feeding Habits of the Feral Ponies, Sika Deer, and Whitetailed Deer Within Assateague Island National Seashore."

Southeast Region

Four new Research/Resources Management reports now are available, through the NPS, Southeast Regional Office, 75 Spring St., S.W., Atlanta, GA 30303:

R/RM Report SER-60,"The Ponds and Lagoons of Horn and Petit Bois Islands, Mississippi, Gulf Islands National Seashore: Their Physical Size, Literature Review and Recommendations for Future Research" by Stephen Shabica and Janet Watkins.

R/RM Report SER-61, "Sea Turtle Nesting at Virgin Islands National Park and Buck Island Reef National Monument," by Vonnie Small.

R/RM Report SER-62, "Reference Marker-Photopoint Resources Management System" by Jerry L. Case, Patrick L. Toops and Stephen V. Shabica.

R/RM Report SER-63, "Vegetation of the Sourthern Appalachians: An Indexed Bibliography," by Harry R. DeYoung, Peter S. White and H. R. DeSelm.

# # # #

A Symposium and Workshop entitled, "Biosphere Reserves and Other Protected Areas for Sustainable Conservation of Smaller Caribbean Islands" is scheduled May 10-12, 1983, at Caneel Bay, St. John, U.S. Virgin Islands. Invited participants will include governmental officials, scientists, and natural resource managers from small Caribbean island nations and the major territories and dependences of the United States and western European countries.

The symposium and workshop will focus on sustainable conservation of small island ecosystems, with particular emphasis on the role of Biosphere Reserves and other protected areas in conserving biological diversity and providing the scientific basis for intelligent management and use of these ecosystems in the Caribbean Basin.

Sponsors include the UNESCO Man and the Biosphere Program, the U.S. NPS, and the Caribbean Conservation Association, among others. In addition, the Park Service plans to dedicate the Virgin Islands NP as an international Biosphere Reserve on the last day of the symposium and workshop. The dedication will draw public attention to the importance of integrated development and the role of biosphere reserves in providing the scientific basis for sustainable conservation of the ecosystems of the region.

Denver Service Center

The NASA Computer System given to the NPS Denver Service Center is now "up and functional," according to Maury Nyquist, Chief, Remote Sensing Section at DSC. Received in 1982, the system became operational in November and presently is engaged in projects such as FIREPRO for Yosemite NP and vegetational mapping of North Cascades NP.

The System consists of a quarter million dollars worth of hardware, backed up with what Nyquist estimates as "several million dollars worth of software." The Earth Resources Laboratory Applications Software (ELAS) allows the processing of multispectral data. The digital data can come from LANDSAT (satellite), from aircraft multispectral scanners (MSS), or from LANDSAT thematic mappers (TM) and can be used in concert with other geographically referenced data in the other half of the System, known as the Geographic Information System (GIS). The GIS allows almost unlimited manipulations of the cellular data for resource management applications of all kinds.

The new Forest Service software developed by the Northern Forest Fire Lab at Missoula, (Fuel Modeling and Fire Behavior Modeling — known as BEHAVE), is being transferred to the System in Denver as part of operation FIREPRO.

MAB Notes

A personal communication from Ric Davidge, Special Assistant to the Assistant Secretary for Fish and Wildlife and Parks at Interior, to the Deputy Assistant Secretary of State for International Organization Affairs, played a key role in the decision of the State Department to maintain the Man and the Biosphere (MAB) Secretariat at State, despite a decision to discontinue funding for the U.S. National Commisssion for UNESCO.

Davidge's letter set forth attributes of the MAB Program that "give it a special potential to promote more effective international cooperation at lower cost than possible through other means." He listed these attributes as (1) established international reputation, (2) unbiased approach, (3) catalytic role, (4) emphasis on initiatives by individuals, (5) high voluntarism, and (6) continuity.

An up-to-date on MAB activities, from William P. Gregg, Jr., MAB Coordinator for NPS, WASO, includes the following:

Nomination of the world's first multiple-site Biosphere Reserve, in the coast redwoods region. The proposed California Coast Ranges Biosphere Reserve consists of six sites, under administration of the NPS, the USFS, the BLM, the California State Parks and Recreation Department, and The Nature Conservancy. It would protect examples of most of the representative ecosystems of the region and provide opportunities for cooperation and a full range of baseline and experimental research activities. Decision is expected in April 1983 by the International MAB Bureau;

Endorsement of Death Valley and Joshua Tree National Monuments as parts of a California-Mojave Desert Biosphere Reserve, by a selection panel chaired by Dan Cheatham of the University of California Natural Areas system;

Pending nominations (approved by MAB in 1982 but not yet designated by UNESCO) of Apalachicola River Unit of the Florida Biosphere Reserve, the Congaree Swamp National Monument, and the New Jersey Pinelands Unit of the Atlantic Coastal Plain Biosphere Reserve. Action on these nominations also is expected in April;

Expected recommendation later in 1983 by a bi-lateral U.S. - Canada selection panel of Biosphere Reserve sites in the Sitkan Biogeographic Province of Southeastern Alaska and western British Columbia;

The planned dedication in May 1983 of the Virgin Islands NP Biosphere Reserve, to be followed by two MAB workshops on conservation of biological diversity in small Caribbean Islands and the establishment and use of marine reserves;

The on-going ethnobotanical survey of the Great Smoky Mountains NP Biosphere reserve. The first survey of the cultural significance of the flora protected in a major national park soon will begin, under a contract with Tennessee State University through the Historically Black Colleges program;

The continuing program of cooperation between the U.S. and the U.S.S.R. on selection and use of Biosphere reserves. Ray Herrmann (Water Resources Lab at Fort Collins), Susan Bratton (University of Georgia CPSU), and Bob Stottlemyer (Michigan Technological University CPSU) were among the U.S. delegation that visited several Soviet Union Biosphere Reserves in October 1982.

In addition, Gregg reports that copies of the comprehensive bibliography and history of scientific activities at the Great Smoky Mountains Reserve are available from him, Special Science Projects Division, NPS, Department of the Interior, Washington, D.C. 20240. Additional projects now underway, or soon to be, are at Big Bend, Channel Islands, Organ Pipe Cactus, Waterton Lakes-Glacier (in cooperation with MAB Canada), Isle Royale, and Virgin Islands NPS.

NATIONAL CAPITAL REGION

Research on the largest squirrel population ever recorded in Lafayette Park, across the street from the White House, has been undertaken by an unusually expert level of volunteers under the direction of Jeness Hall, of the President's Park Unit of NCR. Hall's volunteers work two hours in the morning and two in the afternoon, counting squirrels, observing the food they eat, and photographing their activities. The data is being added to the base compiled two years ago by David Manski, NPS wildlife biologist (whose results were reported in the Winter 1982 issue of *Park Science*). The volunteer researchers, many of whom are professionals in the collection of wildlife and vegetation information, are contributing their expertise in this urban setting in an attempt to determine whether the old, historic trees of Lafayette Park may be in danger from the enormous squirrel population.

FIRE MANAGEMENT REVIEW HELD

One of the more lively discussions at the NPS Annual Fire Management Program Review in Boise, Jan. 24-28, centered on qualifications for persons running prescribed fire programs. According to Dave Butts, NPS Branch of Fire Management, the initial proposal is for a standardized qualification structure, to be implemented in each Region on the basis of the Region's vegetative complexes as represented by fuel models. For instance, Butts explained, the experience needed for carrying out a low-fuel prairie grass fire is much less than that required for a California chaparral fire.

The meeting, attended by Regional fire coodinators and the NPS Branch of Fire Management staff, discussed implementation and status reports of the new FIREPRO activities, editing of a proposed new national fire report, and development of wildland fire equipment specifications.

* * *

The *Oregonian* reports the Oregon Fish and Wildlife Department has a satellite that makes it possible for the first time to project what elk habitat will be in the future. The satellite's sensors are said to be able to distinguish between cover that provides therman protection and cover suitable for hiding, and to show how much forage is available. The new tool is being used in a study that is "likely to provide environmentalists and sportsmen's groups with a potent new weapon in their on-going debate with the timber industry and Forest Service over logging's impact on elk."

Technical Writing As a Tool — An Art

By Jim Wood

Editor's Note: Amen!

The need for high quality in research papers has never been more evident than in today's fast-paced, complex technological age. Our minds boggle from the accelerating expansion of research and all the publications resulting from it. The practicing scientist, manager, or administrator has only limited time to keep abreast of the voluminous literature. His problems multiply and intensify when that literature is verbose, vague, and boring. He deserves to read articles that are technically sound, informative, well-organized, and a pleasure to read. He must be able to grasp information and ideas at a single reading, without having to re-read sentences or puzzle over ambiguities.

Although I believe the writing of many NPS scientists is of high quality, as an editor I have seen no manuscripts that could not be polished and improved. Some have been prepared so poorly and in such careless, sloppy language that they fell far short of the high standards on which the Service must insist. It was impossible to judge their scientific worth until they were translated into reasonably acceptable English.

Some of the best (and some of the poorest) written English I have seen is the work of technical men and women — biologists, geologists, social scientists. Technical writers, whether they realize it or not, start with an advantage. Their basic material is concrete facts and events. Their main object is to describe such and show the relationships between them.

In my judgment, the best technical writing is being done by persons at the top of their professions. They have done important work, understand its meaning, and write about it with confidence. They are bold and sure enough to write simple, direct English.

Too many others, who lack experience and assurance, tend to write with an uneasiness that leads to fog. They smother their meaning in qualification and jargon. Still others are so engrossed in their work that its "special language" has become second nature to them. They overlook how awkward and puzzling this gobbledygook can become when allowed to clot on paper. The scientist who is sure of himself includes, of course, qualification and specialized technical terms when required. But he also recognizes the surplus that can be safely shed. This is an important part of wisdom and essential to clear communication.

I find it ironic that:

1. Most scientists do very well in oral communication, talk simply and clearly, and can explain to a layman what they are doing. But once they begin to write they shun simple English and slip into an odd jargon they consider "traditional" and "safe." They are afraid that if they did otherwise, their writing might seem "unprofessional." It is *never* unprofessional in the sciences to make oneself clear!
2. Although many technical and professional people are poor writers, they read no better and are no less confused by fog than laymen. This is easy to judge from the lively oral discussions often printed following the scientific papers of technical meetings. Many scientists habitually skim the articles, then read closely the oral discussions!

All the foregoing doesn't mean scientists should write their reports for grade-schoolers. Neither should they write their papers as "all things to all people." What I want to emphasize is — *any piece of writing should revolve around the intended reader*. The report should be related to the reader's experience. It should prepare him for what he is about to read. It should be presented in a rational, logical manner and enable him to gain facts and their relationships in the shortest possible time.

Any scientist who writes a paper has spent time gathering facts and contemplating their meaning. The interpretation of meaning is usually the most important part of the paper. The author owes it to the reader to make clear the meaning he has been able to draw from the facts — *without* neglecting to underline points that are still unclear or unsolved. This is especially important for scientists working for public land management agencies like the National Park Service — they have a clear obligation to park managers charged with the stewardship of these lands.

When a scientist writes for those outside his field he should take care to avoid or explain technical terms that are not commonly familiar. In writing for people within his own field, he should review his technical writing self-critically and ask himself: Am I using these words to express or to impress? Am I using them because they are necessary to make my ideas clear? Or am I using them merely to signal that I am an expert?

Four guidelines will help:

1. **Arrange the material logically.** Organize your writing in logical order. Don't begin your report in unknown specifics rather than familiar basics. It is much better to start with something the reader is familiar with and then one section and "meters" or "kilometers" in another. If for some reason we need to use both systems, ordinarily we give the familiar one first, then use parentheses to convert the figures into the other system.

Technical Writing As A Tool (continued)

2. **Prefer the active voice.** Technical writers should make a special effort to avoid a monotonous series of passive constructions; active ones are shorter and more readable. Example:

   PASSIVE:
   The melting point of the alloy was lowered 50 degrees by adding 10 per cent of aluminum.

   ACTIVE:
   Adding 10 per cent of aluminum lowered the melting point 50 degrees.

3. **Don't make nouns out of good, strong "working verbs."** Making nouns out of verbs tends to smother the meaning of sentences. Example:

   SMOTHERED:
   Authorization must be received from the Research Director before utilization of new methods can be incorporated in this project.

   IMPROVED:
   The Research Director must authorize new methods before they are used in this project.

   (Why not "utilize"? Isn't that the verb form of "utilization"? Yes, it is. But "use" is shorter, crisper, and less stuffy.)

The main trouble with smothered verbs is this: anytime you change a working verb to a noun, you must add another verb to complete the sentence. Also, you can see from the above examples that smothered verbs and passive constructions frequently go together. In fact, they are almost inseparable. If you can "unsmother" a verb and, at the same time, change a passive to an active construction, you'll cut sentence length by a third and increase the chance for interest and understanding.

4. **Be concise — cut out excess baggage.** Technical writers should strive to eliminate unnecessary complexity by reducing sentence length. Example:

   ORIGINAL:
   Comparison of data obtained with these paints using Barco with those using Lenol revealed that use of Barco solvent slowed the drying appreciably (approximately doubling the time in most instances) but had very little effect on the viscosity characteristics obtained.

   REVISION:
   The data showed paints using Barco were no more viscous than those using Lenol, but dried only about half as fast.

The above guidelines do not cover every possible "poor writing" situation — just a few of the more common ones. For those who wish to learn more, I suggest this paperback: *Writing with Precision* by Jefferson D. Bates. Published by Acropolis Books, Ltd., Washington, D.C. 20009; $6.95 per copy.

In these days, more than ever before, the reading time of a scientist is precious. Few of them like the task of writing. But writing is the chief means (and permanent record) of handing on what they have learned.

Remember — write for the reader, not the filing cabinet! And most of all, write *to inform* — not to prove that you're smarter than your readers!

Wood is technical publications editor with the NPS Southeast Regional Office.

Computerized Data Base Built For Vacular Flora of NP System

By Gary S. Waggoner and Nancy K. Thorwardson

Over the past several years, a service-wide need has grown to obtain basic information in an accurate, efficient manner about the vascular flora of the National Park System. Recently, the Service has needed information concerning the distribution of plants sensitive to air pollutants, the presence and distribution of exotic versus native species, and rare, threatened, or endangered species in the System. A systematic listing of such plants, called a "flora", for any one park unit has limited value when questions arise concerning species in all or a group of parks.

The collection and merging of these park floras into a single Park Service Flora would enable researchers to address these questions. Consequently, the Air Quality and Natural Science Divisions, Office of Science and Technology, WASO, initiated such a project in FY '82 and requested the Branch of Special Programs, Denver Service Center to construct a computerized data base of vascular flora in the National Park System. The objectives used in designing the data base were described by James P. Bennett in the George Wright Society *FORUM*, Spring 1982 "*A Computerized Flora of the National Parks.*" A core staff of four was formed to conduct the work; Gary S. Waggoner, Project Manager/Botonist; Nancy K. Thorwardson, Data Base Manager; Connie L. Malcolm, Data Entry Technician; and Ronald J. Buss, Computer Consultant.

Seventeen class I park units (those units given the most stringent level of protection from the effects of air pollution under the Clean Air Act as amended in 1977) were chosen for entry into the data base by the Air Quality Division. The 17 units occur in all NPS Regions except Alaska and the National Capital Region. Personnel at the park units were contacted and the latest checklists on floras of vascular plants for each park were obtained.

Two recently produced computerized inventories of the vascular flora of North America are:

A Synonymized Checklist of the Vascular Flora of the United States, Canada, and Greenland — Volume II, The Biota of North America, by John T. and Rosemarie Kartesz, 1980 (The University of North Carolina Press, Chapel Hill, NC); *The National List of Scientific Plant Names*, (NLSPN), a 1982 publication of the Soil Conservation Service (SCS-TP-159), comprised of two separate volumes: Volume I — List of Plant Names, and Volume II — Synonomy.

Both publications are current and represent professional treatments of the Nation's flora but are decidedly different in nomenclature. Our work uses the NLSPN as the principal source document, following its nomenclature and synonomy wherever possible. The Kartesz and Kartesz publication is used whenever the NSLPN does not adequately treat a particular taxon. One of the strongest reasons for making this selection is that the NLSPN includes distribution and habit (information on general characteristics) which is especially useful for the NPS data base:

1. Distribution in North America (including Alaska, Hawaii, Canada, and the Carribean)
2. Annual/biennial/perennial
3. Native/introduced
4. Submersed/emergent/floating
5. Epiphytic/parasitic/saprophytic
6. Woody/partly woody/succulent
7. Tree/shrub/vine/herbaceous forb-/grasslike herb

The procedure used to develop the NPS data base, called *NPFLORA*, was to enter the appropriate park data to the NLSPN for each plant appearing in the park floras. In numerous instances (an estimated 10 percent of the taxa) recent changes in botanical nomenclature required the project manager to update the scientific names of the plants. In a few cases (less than 1 per cent of the taxa) the proper scientific name could not be determined. These problems will be resolved in future consultation with appropriate park staff. Infraspecific taxa at the forma level were not included in the data base. Such taxa are listed at the species, subspecies, or variety level.

The analysis package used with *NPFLORA* is SYSTEM 2000, a data base management system developed and maintained by Intel Systems Corporation. SYSTEM 2000 offers great flexibility in design and use of a data base and, more importantly, in update and revision. Query capabilities are virtually limitless and SYSTEM 2000 includes a Report Writer Feature that allows the user to define and generate many different report formats.

Levels of information in the data base include; Family, Genus, Species, Infraspecies (subspecies and/or variety), Habit (General Characteristics), Distribution,

Computerized Data Base (continued)

and Parks. The hierarchical, or "tree" structure of the data base allows rapid, cost effective searches and minimizes file sizes and storage costs. Queries may be made at any level of the hierarchy. For example, a user may wish to determine in which parks *Ranunculus repens* (creeping buttercup) occurs, and to discover the habit and distribution characteristics of the plant. A simple run of SYSTEM 2000 on the *NPFLORA* data base yields the information presented in Fig. 1.

```
6* RANUNCULACEAE
  12* RANUNCULUS
    22* REPENS
        41* I
        42* I
        43*
        44* P
        45* F
        49* 123 . . 6 . 890AH . . WEMG
          51* OLYM
          51* ROMO
          51* SHEN
          51* GRSM
          51* ISRO
          51* SEKI
```

Figure 1: Query about *Ranunculus repens*

The species occurs in 7 of the 19 parks currently in the data base: Olympic, Rocky Mountain, Shenandoah, Great Smoky Mountains, Isle Royale, Sequoia and Kings Canyon. The plant is introduced to the continental United States and Hawaii, is a perennial, and is herbaceous. It occurs in regions 1,2,3,6,8,9,0,A,H,W,E,M, and G (Fig. 2).

The user may also make park-specific queries. For example, a query concerning introduced (exotic) plants in the Black Canyon of the Gunnison, yields the information that there are 17 (Fig. 3). Further inquiry reveals that these introduced species comprise approximately 8 percent of the total vascular flora in the park, and 35 percent of the introduced species are annuals.

Figure 3. Introduced Plants in the Black Canyon of the Gunnison NM

Agropyron desertorum
Agrostis alba
Bromus commutatus
Bromus inermis
Bromus tectorum
Poa glauca
Urtica dioica
Brassica juncea
Lepidium perfoliatum
Sisymbrium altissimum
Rubus idaeus
Hypericum perforatum
Tamarix galica
Convolvulus arvensis
Lappula redowskii
Carduus nutans
Cirsium arvense

It also is possible to determine the presence of a specific plant in a specific park, such as *Agrostis alba* in Great Smoky Mountains National Park. The examples presented represent only a few of the many query possibilities available. The system is flexible and efficient; the example data were generated in a single run of five minutes.

Currently 7019 taxa of vascular plants, from 19 Class I units, have been entered into *NPFLORA*. The Class I units are:

Acadia NP
Big Bend NP
Black Canyon of the Gunnison NM
Canyonlands NP
Chiricahua NM
Everglades NP
Great Sand Dunes NM
Great Smoky Mountains NP
Guadalupe Mountains NP
Isle Royale NP
Kings Canyon NP
Lava Beds NM
Mesa Verde NP
Mount Ranier NP
Olympic NP
Rocky Mountain NP
Sequoia NP
Shenandoah NP
Theodore Roosevelt NHP

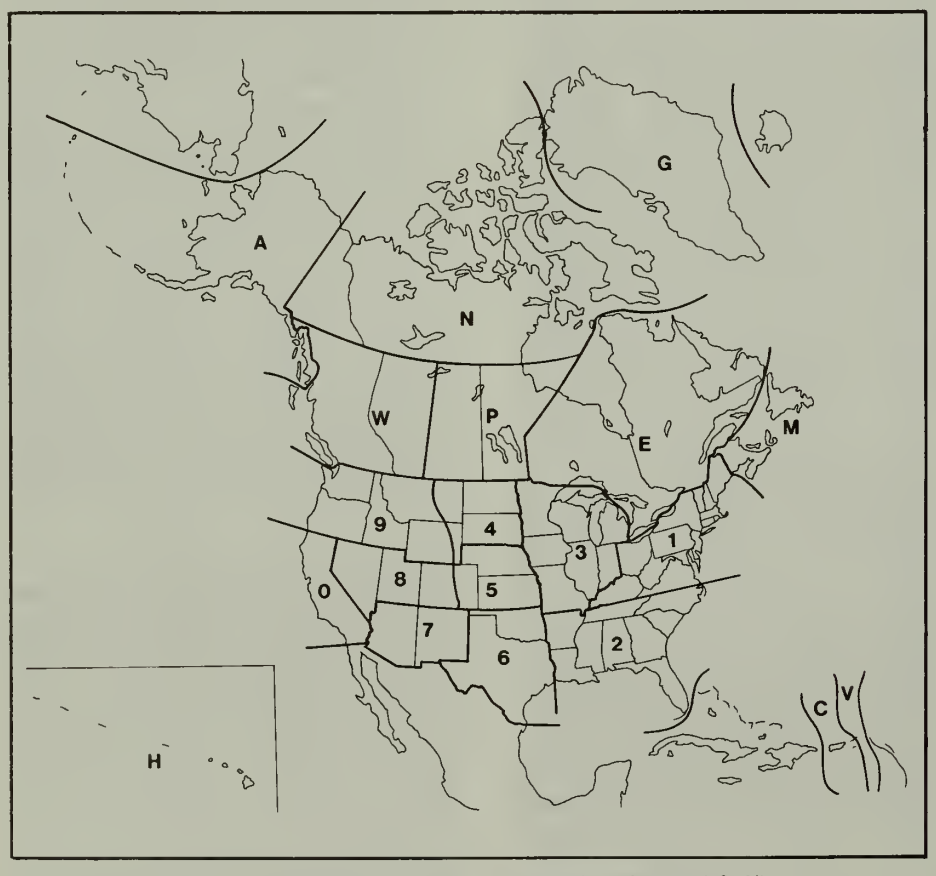


Figure 2: Regional Distribution Map (Taken from NLSPN)

FLORISTIC DATA ON SELECTED CLASS 1 NPS UNITS

(Data in NPFLORA as of 2/15/83)

Total number of taxa: 7019
Total number of families: 187
Total number of native taxa: 6146
Total number of introduced (exotic) taxa: 655
Percentage of total flora which is native: 88%
Percentage of total flora which is introduced (exotic): 9%

PARK	TOTAL	INTRODUCED %	NATIVE %	UNKNOWN %
ACAD	*268*	*40 (15%)*	*218 (81%)*	*10 (4%)*
BIBE	*960*	*48 (5%)*	*902 (94%)*	*10 (1%)*
BLCA	*213*	*17 (8%)*	*193 (90%)*	*3 (2%)*
CANY	*321*	*23 (7%)*	*294 (92%)*	*4 1%)*
CHIR	*392*	*36 (9%)*	*352 (90%)*	*4 (1%)*
EVER	*809*	*127 (16%)*	*642 (79%)*	*40 (5%)*
GRSA	*248*	*14 (6%)*	*231 (93%)*	*3 (1%)*
GRSM	*1419*	*238 (17%)*	*1127 (79%)*	*54 (4%)*
GUMO	*889*	*46 (5%)*	*833 (94%)*	*10 (1%)*
ISRO	*688*	*89 (13%)*	*587 (85%)*	*12 (2%)*
LABE	*234*	*31 (13%)*	*201 (85%)*	*2 (1%)*
MEVE	*422*	*54 (13%)*	*361 (85%)*	*7 (2%)*
MORA	*478*	*48 (10%)*	*418 (87%)*	*12 (3%)*
OLYM	*1228*	*239 (19%)*	*972 (79%)*	*17 (1%)*
ROMO	*893*	*59 (7%)*	*822 (92%)*	*12 (1%)*
SEKI	*1834*	*130 (7%)*	*1667 (91%)*	*37 (2%)*
SHEN	*1021*	*203 (20%)*	*772 (76%)*	*46 (5%)*
THRO	*314*	*31 (10%)*	*276 (88%)*	*7 (2%)*
TOTALS:	12,631	1473	10,868	290
AVERAGE:	702/park	82/park (12%)	604/park (86%)	16/park (2%)

Editor's Note: Park Science will print an up-date of this Data on a semi-annual basis.

The 19 units represent 40 percent of the total number of Class I parks and 6 percent of the total units in the System. Table I contains summary data for the *NPFLORA* data base.

The goal for FY'83 is to enter into *NPFLORA* 30 additional floras, with priority given to Class I units. In addition, a survey is being conducted to identify those units for which reasonably complete floras are available. Plans for the future include the entry of all available floras, thus providing the National Park Service with a valuable tool for science and resource management.

The development of *NPFLORA* is being funded jointly by the Air Quality and the Natural Science Divisions, WASO. The choice of parks that are entered into the data base is made by scientists in those divisions. Copies of the FY '82 Status Report were recently sent to all Regional Chief Scientists and Regional Air Quality coordinators. At this time, the Science and Remote Sensing Sections will perform searches and queries of the data base at no cost, but in the future, users will pay for requested searches. If you have questions or queries of the data base, please contact the authors in the Denver Service Center (FTS 234-4527) or the Air Quality Division (FTS 234-6620).

Thorwardson is a geographer and Waggoner is a plant ecologist at the NPS Denver Service Center.

The authors, Waggoner and Thorwardson, are shown here querying NPFLORA via their remote terminal at the Denver Service Center.

Haleakala Silversword: An Optimistic Note

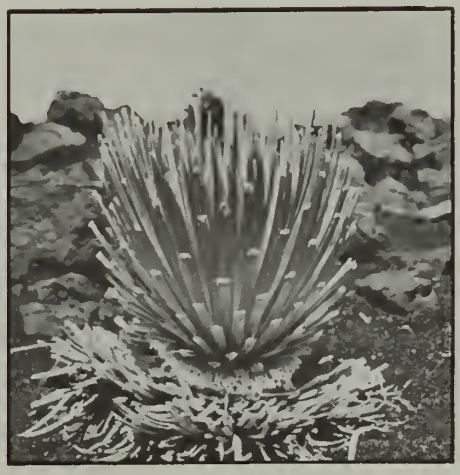
By Lloyd Loope

Our research group at Haleakala is investigating the population biology of a number of the park's endemic plant species as part of a program to develop long-term management strategies. The prognosis for many native species is not good unless management efforts by the NPS succeed in drastically reducing feral pig and goat populations. Hawaii is an exciting place for a biologist to work only if one can avoid depression and despair at the continuing precipitous decline of one of the world's most remarkable biotas.

Not all species are declining, however, and we are pleased to report that despite reports to the contrary (e.g., S. Carlquist, **Bioscience** 32(5):350, 1982), the Haleakala silversword *(Argyroxiphium sandwichense)* is doing just fine - at least for now. We have initiated a long-term investigation involving silversword population monitoring and biology in view of the importance of preserving this species. The silversword receives more attention from visitors to Haleakala than any other species because of its bizarre and beautiful appearance and its uniqueness. Scientific interest in this and closely related taxa is substantial. *The Argyroxiphium-Dubautia* group, consisting of about two dozen species, is one of the best existing examples of the evolutionary phenomenon known as adaptive radiation. Detailed studies of the evolution and physiological ecology of this group, underway by Dr. Gerald Carr of the University of Hawaii and Dr. Robert Robichaux of the University of California at Berkeley, will yield much basic information regarding evolutionary processes.

The Haleakala silversword has historically received considerable attention from park managers because it has, in the past, appeared in danger of extinction. The long-term survival of the silversword is clearly somewhat precarious because of its restricted habitat, moderate numbers, its monocarpic habit (it grows for 7-20 years in a rosette stage, then flowers and dies), and its dependence on establishment of seedlings (virtually no vegetative reproduction). Flowering is sporadic, with heavy flowering in some years and no flowering in other years. Preliminary indications are that cross-pollination by endemic insects is essential for adequate production of viable seeds. Loss of pollinators (for example, perhaps due to predation by some introduced predatory insect, such as the ground-nesting yellow-jacket, *Vespula pennsylvanica*) could be disastrous. In the past, much concern has been focused on the seemingly precarious relationship between the silversword and its native seed predators. Concern was certainly warranted, since by the late-1920's goat and cattle browsing and human vandalism had reduced the once abundant

#2 - **Larvae of** *Plagithmysus terryi,* a long-horned *(Cerambycidae)* beetle endemic to Haleakala, feed in the pith of silversword roots (shown here) and stems of flowering plants. About a dozen endemic insects are associated with the silversword.



#3 - **Goat-damaged** silversword. Fortunately, browsed plants are the exception rather than the rule for the remaining silversword population.

#1 - One of the 2200+ silverswords that flowered in 1982.

Haleakala silversword to a few thousand plants occupying only a fraction of its former range.

By the 1930's, it was determined that a dozen or so species of endemic insects are associated with the silversword. Some of these seem to be dependent on the silversword for carrying out their life cycles. Several insects are seed predators, and in some years these were observed to consume most of the seed produced. Some experimentation was carried out involving burning of dead silversword plants to destroy larvae of predatory insects. As late as the 1960's, consideration was given to use of insecticides to protect silverswords from their native insect predators.

Fortunately, the silversword population has been building up for the past 50 years. Numbers have increased from a few thousand to about 50,000 as shown by our 1982 census. The summer of 1982 was the best flowering season for silverswords yet recorded in Haleakala, with over 2,200 plants in bloom. The increase seems to be the result of removal of cattle and near elimination of human vandalism. Goats continue to impact silverswords, especially at the periphery of their present range, and prevent them from reoccupying former range.

Still, little is known regarding silversword population dynamics and silversword-insect relationships. Our project hopes to remedy this situation. In preliminary work last summer, we established plots for long-term monitoring of silversword populations. We also examined insect damage to seeds and seed viability in a year of heavy flowering. With the help of Betsy and Wayne Gagne of the B.P. Bishop Museum, we are trying to quantify the impact of various insects on the silversword population.

We found that both insect damage and seed viability were high in early-flowering plants, whereas insect damage and seed viability were very low in late-flowering plants. It is too early to say, but it seems possible that pollination and seed consumption may result from different stages of the life cycle of the same insect. The hazards of tinkering with a biological system of which we know little are becoming obvious. Successful control of the seed predators by management could have resulted in elimination of the plant species management was hoping to protect.

I personally find the silversword-insect relationship one of the most interesting phenomena I have encountered in 20 years as a biologist. It seems clearly appropriate for the NPS to regard the endemic insects as a resource comparable in value to the silversword. I find it very encouraging that such a finely-tuned relationship has survived so far, in spite of feral animal and human impacts which have proved devastating to other Hawaiian biota. We are fortunate that the silversword has not met the fate of its close relative, the Haleakala greensword. *(Argyroxiphium virescens* var. *virescens)*, which became extinct in the 1930's - presumably along with an associated complex of native insects.

PARK SCIENCE

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